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Pasture Development.

A Project in Collaboration with the Australian Dairy Produce Board Pasture Improvement Committee (W.A.).

Part III.

ROTATIONAL GRAZING DEMONSTRATION UNDER IRRIGATED CONDITIONS.

H. G. Elliott, Agrostologist.

F. E. Ryan, Field Technician.*

SUMMARY OF INFORMATION OBTAINED.

1. *Cover crops* should not be used when establishing irrigated pastures.
2. Less grazing was obtained in the first year when cover crops were used.
3. It is not profitable to use any of the cover crops mentioned but certified perennial rye-grass sown at the rate of 2-4 lb. per acres as a pasture species is beneficial.
4. White clover establishment was very seriously affected by the cover crops.
5. Paspalum was not seriously affected by cover crops.
6. Good grazing and production results were obtained from careful soil preparation and management of the subsequent pasture.
7. Four hundredweight of superphosphate per acre applied annually, the bulk of it in the autumn, will give good returns. Lighter applications are not generally recommended.
8. Strict attention should be given to the grazing management and care taken to see that the pastures are not grazed too close, nor allowed to grow too rank, at any one period of the year.
9. Harrowing during the winter months, and the use of the mower, to top pastures when necessary, is sound policy.
10. From results obtained the average dairy cow eats about 23 tons of green material per annum, and consequently should be put into paddocks with ample good feed.

* Field Technician employed by A.D.P. Board Pasture Improvement Committee (W.A.).

11. High carrying capacity was obtained from a number of small paddocks. This shows the advantage of subdivision.
12. It has been possible with care to regulate the water on to paddocks where furrow irrigation is used so that the desired quantities can be applied.
13. The high production and good condition of the pastures after four years, receiving during the irrigation period, four inches at three-weekly and 5⅓ inches at four-weekly intervals indicates that the present high rate of 7-12 inches per irrigation in the Collie irrigation area is excessive and wasteful.
14. Four-inch waterings at three-weekly intervals will maintain growth and high production.
15. With five and one-third inch waterings at four-weeky intervals, some wilting of white clover was recorded.
16. No conclusive results were obtained from the irrigation trial.

INTRODUCTION.

During 1934, the State Committee of the Australian Dairy Council, whose work was continued by the Australian Dairy Products Board Pasture Improvement Committee (W.A.) made available sums of money to be used towards demonstrating to dairy farmers the value of subdivision for increasing the carrying capacity of holdings. Large areas had recently been converted from dry land farms into irrigation farms and little information was available regarding the most economical method of developing permanent pasture on the types of soil represented. The State Committee, therefore decided to co-operate with the Department of Agriculture in establishing a demonstrational area on the property of the late Mr. A. E. Jackson of Roelands. This property is now farmed by Mr. W. D. Moore. It is fully realised that the experiment laid out hereunder has not been an attempt to obtain fundamental information, but to obtain sufficient data to act as a guide to farmers who have taken an interest in the progress of the experiment since its inception.

Aim and Objects.

SECTION A.

1. The collection of information as to whether it would be more profitable to establish permanent pasture with a cover crop than to sow the permanent perennial pasture species alone.

2. The collection of data regarding the carrying capacity of small irrigated areas.

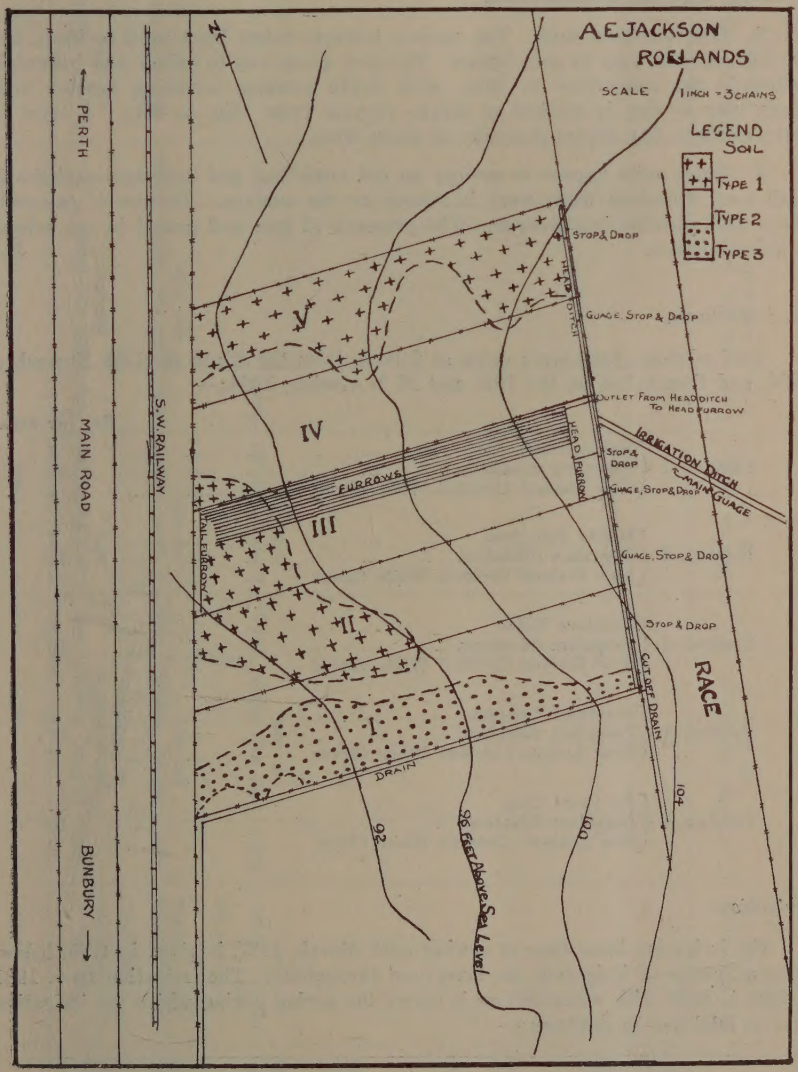
3. The collection of data to show the change in composition of the pasture, under rotational grazing with irrigated conditions.

4. To obtain as near as possible the monthly yield of green material in tons per acre.

Materials and Methods.

An area of 13.31 acres of land of which 12.9 acres had been cultivated previously was subdivided into five paddocks and permanent water laid on each paddock. The area when taken over, had a crop of oats on it. This was fed off during the winter months, the whole area ploughed with a mouldboard plough on the 15th September, 1934, ploughing being completed by the 17th October.

A small area at the north-eastern end of paddock 5 was graded to make it suitable for irrigation and a further small area on the north-western end of paddock 1 was never fully pastured on account of clumps of young trees. The area was then harrowed in preparation for seeding.



Soils.

The soils of the area are relatively uniform and are obviously forming on material deposited by outwashes from the range. There is evidence that the course of a creek once ran along the south boundary of paddock 1, and at the eastern portion of the boundary between 3 and 4, grits in the subsoil are indications of recent water action.

Three distinct soil series were recognised on the area.

1. Brown and red-brown surfaced soils. The surface soil is brown to red-brown and the subsurface layers red-brown to yellow-brown. The subsoil is yellowish with clay accumulation.

2. Grey-surfaced soils. The surface textures range from sand to loam, and the colours from grey to grey-brown. The grey gives way to yellow and brownish-yellow in the subsurface to 30in., with depth textures becoming heavier until sandy clay or clay is reached at depths varying from 15in. to 69in. A layer of non-absorbent clay occurs generally at about 60in.

3. These soils appear to occupy an old creek bed and are characteristically dark grey (blackest when wet) in colour on the surface. Texture is generally heavy and variable in character. The presence of grit and gravel in the subsoil is quite common.

Seed Mixtures.

Seed mixtures were sown down as follows from the 8th to the 12th November, 1934, and then rolled on the 19th and 20 November, 1934:—

		lbs. per acre.
Paddock 1	Sudan Grass	7
	Paspalum dilatatum	10
	New Zealand Certified White Clover	2
Paddock 2	Italian Rye-grass	7
	Paspalum dilatatum	10
	New Zealand Certified White Clover	2
Paddock 3	Japanese Millet	5
	Paspalum dilatatum	10
	New Zealand Certified White Clover	2
Paddock 4	Perennial Rye-grass	7
	Paspalum dilatatum	10
	New Zealand Certified White Clover	2
Paddock 5	No Cover Crop	...
	Paspalum dilatatum	10
	New Zealand Certified White Clover	2

Irrigation.

The irrigation from time of sowing until March, 1937, is given in table below. Furrow system of irrigation has been used throughout. The irrigation from 1937 to 1940 is dealt with separately as it covers the period during which the irrigation interval trial was in progress:—

1934.	1935.	1936.	1937.
December 6th	January 29th	January 19th	January 27th
December 29th	February 27th	February 21st	February 28th
	December 14th	March 25th	March 27th
		December 6th	

TABLE (a)—FERTILISER.

1935.		1936.		1937.		1938.		1939.		1940.	
2 cwts. Super. + Ammonia No. 3 per acre	Nov., 1934	1 cwt. Super. per acre prior to watering	Jan.	150 lbs. Super. per acre prior to watering	Jan.	1 cwt. Super. per acre	Jan.	180 lbs. Super. per acre	Jan.	3 cwts. Super. per acre	May
1 cwt. Super. per acre before watering	Jan., 1935	1 cwt. Super. per acre + 28 lbs. Sulphate of Ammonia per acre	Apl.	280 lbs. Super. per acre	May	3 cwts. Super. per acre	May	300 lbs. Super. per acre	June		
70 lbs. Super. per acre before watering	Feb., 1935	130 lbs. Super. per acre	Nov.,	170 lbs. Super. per acre	Aug.,	1 cwt. Super. per acre	Sept.				
2 cwt. Super. + 56 lbs. Sulphate of Ammonia per acre	Apl., 1935										
1 cwt. Super. before watering	June, 1935										
Two-thirds each plot received 3½ cwts. Lime per acre	June, 1935										
2 cwts. Super. per acre	Aug., 1935										
1 cwt. Super. per acre	Dec., 1935										
Total: 1,134 lbs. Fertiliser	...	374 lbs. Super. + 28 lbs. Sulphate of Ammonia	...	600 lbs. Super. per acre	...	560 lbs. Super. per acre	...	480 lbs. Super. per acre	...	336 lbs. Super. per acre	...

Botanical Analyses.

In June, 1935, some six months after the establishment of the trial, it was considered advisable to carry out monthly botanical analyses for at least 18 months on each paddock to determine during the first year the effect of the cover crop on the actual pasture and also to determine what period of the year each constituent of the pasture made maximum growth. These botanical analyses were made with a 10 inch square quadrat which was thrown at random at least 20 times on each paddock.

Grazing.

Rotational grazing as carried out at the discretion of the farmer, the interval between grazing varying considerably. The time in hours during which the stock were grazed was recorded and the amount of grazing obtained was measured by the product of the number of cows grazing on one paddock at any particular time and the time in hours during which it was grazed.

Renovation.

1934: The area was ploughed and harrowed in September, seeded 8-12 November, and rolled on 19-20th November.

1935: The paddocks were harrowed prior to watering in the autumn.

1936: The paddocks were harrowed four times. Once in February prior to watering, twice during the winter, and once during November. The whole area was mown during April and the surplus raked off.

1937: The paddocks were harrowed on April 11th and on August 28th. They were mowed on February 28th and the surplus material raked off.

1938: On 27th July the area was carefully renovated with a rotary prong renovator followed by a zig-zag chain harrow combination. On 19th August the irrigation furrows were cleaned out with a modified "Sun-buster" plough. The spoil was broken down with a disc-cultivator and a T-bar roller.

On 25th July rushes which were accumulating in the furrows were slashed, removed and burnt.

On 10th November all rushes were grubbed out, carted off and destroyed.

1939: Renovated in June with a rotary prong type of renovator followed by blade harrows with half chain harrows.

Whole area was mown twice in summer to prevent seeding of paspalum and the spread of ergot.

RESULTS.

The results obtained from this experimental area may be conveniently divided into two sections A and B. Section A deals with the period 1934 to 1938 and is concerned with the effects of cover crops on the establishment, growth and production of this pasture.

Section B deals with the period 1938 to 1940, during which the effect of varying the time interval between waterings on the production growth and composition is measured.

One set of tables and graphs has been used to gather these results into coherent units and consequently in section B reference will be made to graphs and tables which are included under section A.

Cover Crops.

The effect of the cover crops on the establishment, growth, and production of this pasture has been assessed in four ways:—

(i) Grazing.

(ii) Yields of green material.

(iii) Botanical analyses.

(iv) Production of milk and butter fat.

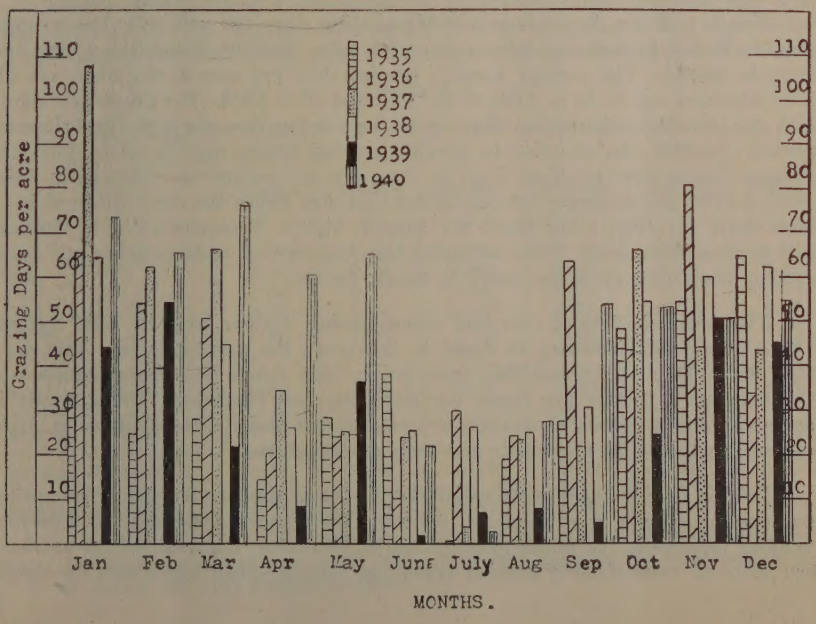
(i) *Grazing.*—Table 1 summarises the grazing obtained from the experimental area over the whole of the period 1934-1940.

TABLE 1.

Year.	Grazing Hours.	Total Grazing Days.	Grazing Days per Acre.	Acres per Cow.
1935	38,373	4,796·6	371·2	0·97
1936	47,019	5,877·4	496·1	0·73
1937	52,200	6,525·0	506·6	0·72
1938	49,430	6,178·7	480·5	0·76
1939	30,001	3,750·0	290·7	1·25
1940	62,988	7,873·5	610·8	0·60
Average, 1935–40	46,668·5	5,833·5	459·3	0·84
Average, 1936, 1937, and 1938	49,549·7	6,192·7	494·4	0·737
Average, 1936, 1937, 1938, and 1940	52,909·3	6,613·7	523·5	0·70

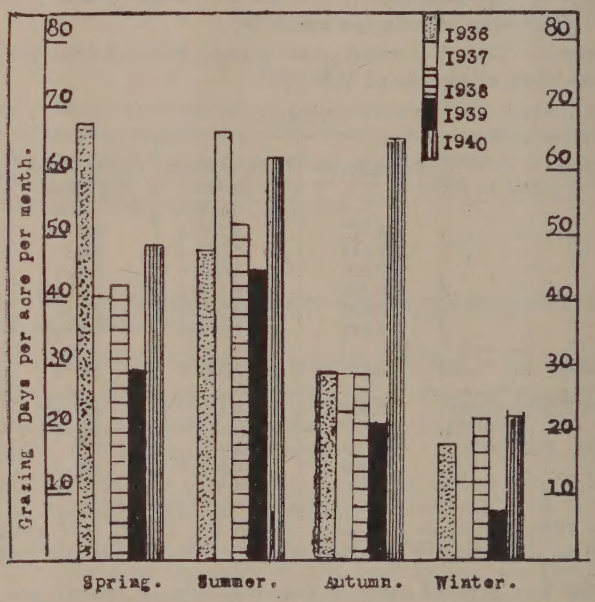
During 1935, the whole trial area carried one cow to 0.97 acres. From the table it will be seen that the carrying capacity increased during 1936 to one cow

Graph 1 - Average Monthly Grazing Days (8 hours) per acre.



to 0.73 acres and remained fairly constant over the three years 1936, 1937, and 1938, carrying an average of one cow to 0.74 acres. Subsequent results belong to section B. The distribution of the grazing throughout the year is shown in graphs 1 and 2.

Graph 2.
Showing three-monthly seasonal grazing.



Graph 1 shows the average monthly grazing days per acre over the six-year period. It will be seen that most grazing has been obtained during the spring and summer months. The average monthly grazing days per acre during 1935 was 31. This was increased to 41 in 1936, 42 in 1937, and 40 in 1938. The graph also shows that considerable variation has occurred in the grazing throughout the experimental period. In 1935, the variation in monthly grazing figures may be seen. Thus the grazing figures were relatively high in June and no grazing was obtained in July. During 1936, the sequence was as follows:—A low figure for June followed by a high figure for July, a low figure for August, high in September, low in October, and high in November. Thus an undesirable sequence of under-grazing and over-grazing has shown up in the month by month figures.

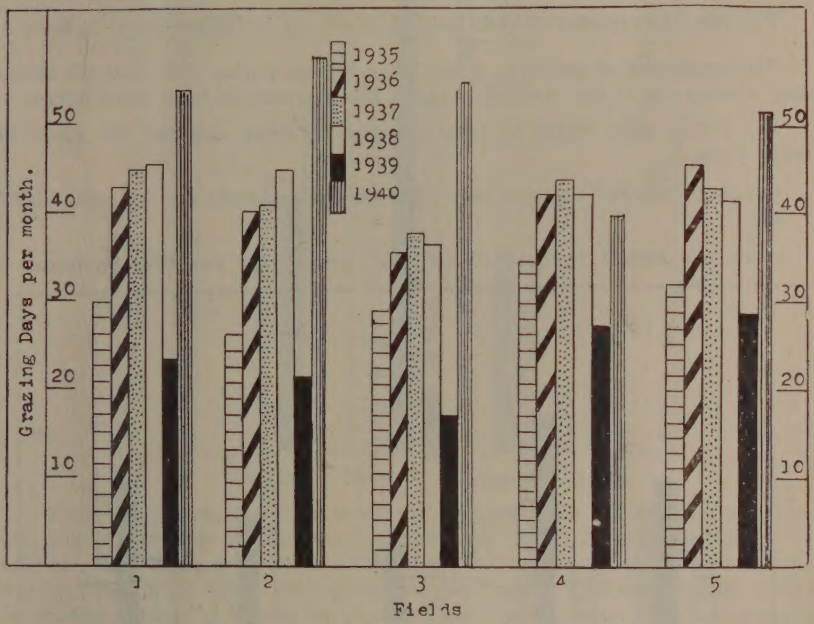
The seasonal effect of over and under-grazing is clear from the 1937 figures. During the period January to April in that year, the grazing figures were very high, from May to October they were low, a high figure was again obtained in October, and a further low figure for November and December. Consequently it appears the over-grazing during the summer-autumn period from January to April caused a reduction in the winter and early spring grazing.

During 1938, a much more satisfactory grazing was carried out. The spring and summer grazing were decreased from the 1937 figures and there was a corresponding increase in the winter grazing figures. However, the result of the previous two years of unsatisfactory grazing appear to have had their effect with the result

that the carrying capacity during 1938 showed a decrease from that of the previous year. (See table 1.) This is probably an annual effect of incorrect grazing management.

The grazing days per acre per paddock are summarised in graph 3.

Graph 3 - Grazing Days (8 hours) per acre



During 1935 paddock 4 (perennial rye-grass cover crop) provided most grazing, followed by No. 5 (no cover crop), 1 (partial Sudan grass cover crop), 3 (Japanese millet cover crop), and 2 (Italian rye-grass cover crop) in that order.

TABLE 2.

CARRYING CAPACITY IN ACRES PER COW, 1935–1940.

Year.	Paddock 1.	Paddock 2.	Paddock 3.	Paddock 4.	Paddock 5.	Average.
1935	1·01	1·09	1·03	0·85	0·95	0·97
1936	0·71	0·76	0·83	0·72	0·69	0·74
1937	0·68	0·77	0·85	0·78	0·73	0·72
1938	0·69	0·88	0·81	0·72	0·75	0·77
1939*	1·29	1·42	1·13	1·60	1·06	1·20
1940	0·55	0·52	0·55	0·76	0·58	0·60
Average, 1935–40 ...	0·82	0·91	0·87	0·82	0·79	0·84
Average, 1936–38 ...	0·69	0·80	0·82	0·74	0·72	0·75
Average, 1938–40 ...	0·84	0·94	0·83	0·86	0·80	0·86
Average, 1936–40 ...	0·78	0·87	0·83	0·82	0·76	0·81

* Pastures on all paddocks never fully grazed throughout the year but particularly in the Spring and early Summer months.

During 1936, the order was paddock 5, 4 and 1, 2 and 3, and during 1937, it was 1, 4 and 5, 2 and 3.

It will be seen differences existing during 1935 have evened out until all paddocks, with the exception of 3, have become approximately equal in the number of grazing days provided per acre.

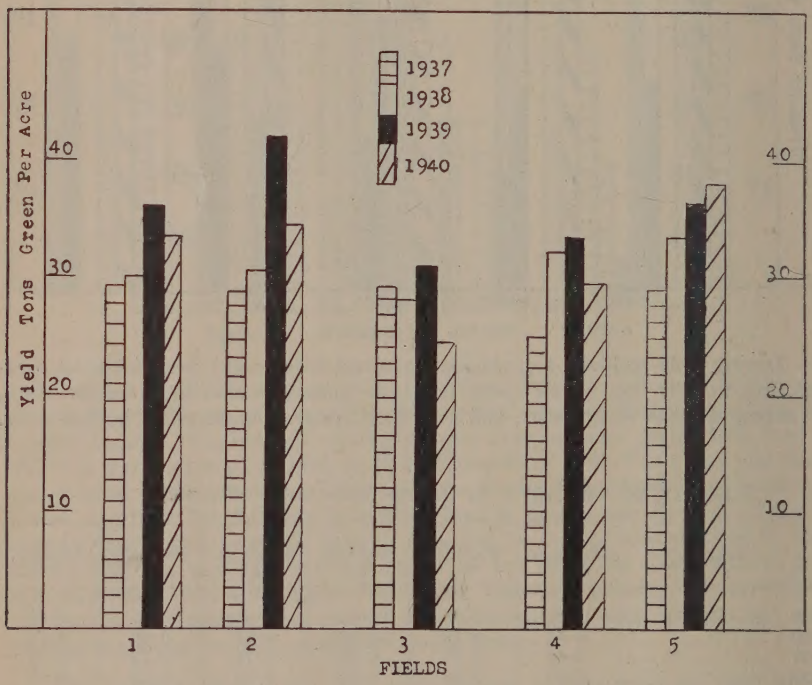
The carrying capacity of each paddock is set out in further detail in table 2.

The superiority of paddocks 4 and 5 can be seen during 1935, and the subsequent evening out of the carrying capacity becomes obvious from these figures.

(ii) *Yields.*—The yields in tons per acre of green material are given in graphs 4 and 5.

Graph 4 gives the yield per acre from the five paddocks for the period 1937 to 1940.

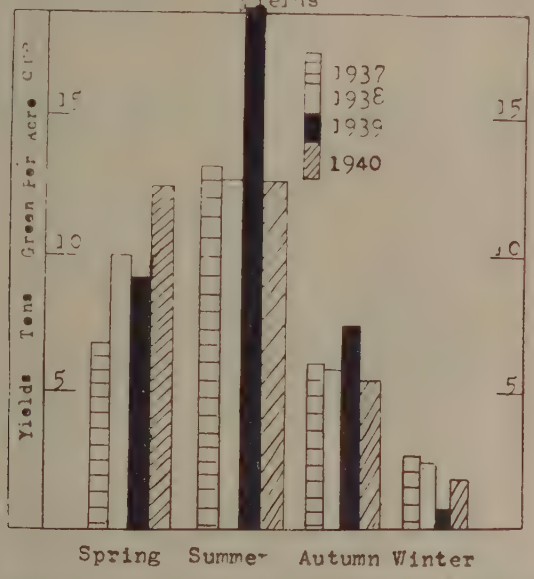
Graph 4 - Annual Production in tons, green, for the five Paddocks.



This graph shows that during 1937, some discrepancy occurred between the production of green material and the grazing figures. Owing to the irregular nature of the grazing carried out on these paddocks certain discrepancies must be expected. In the main, the two graphs show similar tendencies. For the years 1937 and 1938, it is obvious that all paddocks have approximately equal production but No. 3 is slightly inferior and No. 5 slightly superior to the other three. On this basis, that all paddocks have reached approximately the same state of production, the irrigation interval section of the experiment was begun and subsequent results must be dealt with under section B.

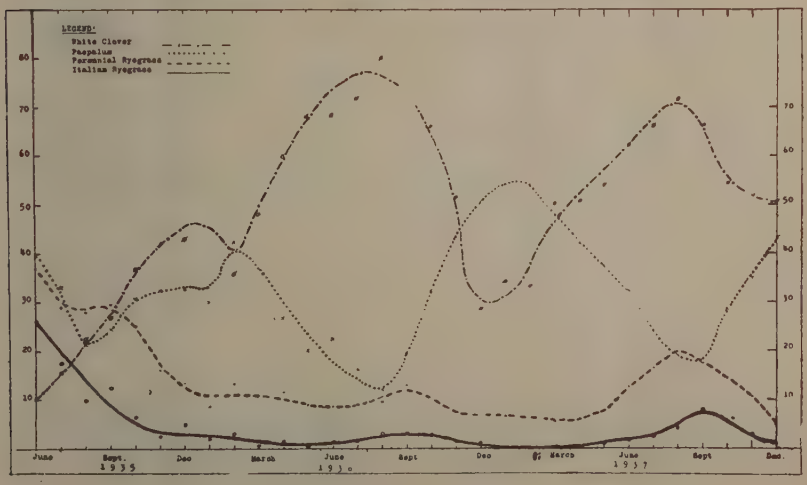
Graph 5 shows the variation in production throughout the seasons of the years.

Graph 5 - Showing three-monthly seasonal yields



From this graph it will be seen that the production for the summer period was almost equivalent for the two years 1937 and 1938. The grazing during 1937 was in excess of that for 1938. This illustrates the overgrazing which occurred during 1937. More winter grazing was obtained during 1938 than in 1937, yet the production during the winter for the two years was the same. This was probably the direct result of the over-grazing during the summer of 1937.

Graph 6.- Percentage cover of various species



(iii) *Botanical Analyses.*—From the figures obtained it was found that in 1935, where no cover crop has been grown on paddock 5, the highest percentage total cover was obtained while least total cover resulted from the establishment under a Japanese millet cover crop. Paddock 1, which carried a partially successful cover crop of sudan grass, was somewhat better than No. 3 in total cover.

Paspalum was not seriously affected by the growth of the cover crop on any paddock with the possible exception of No. 2 where the growth of Italian rye-grass seems to have had a temporary effect.

It was also found, however, that the cover crop had a profound effect on the establishment of white clover and that the establishment varies inversely with the density of the cover crop.

The behaviour of the rye-grasses is indicated in graph 6 which shows graphically the seasonal percentage cover of the various species.

From this graph the white clover predominance during the winter period is obvious as is the summer dominance of paspalum. The percentage of the rye-grasses decreased from June, 1935, to a constant figure with a regular increase during the spring months.

It was also found from the botanical analyses that with the advent of the cold weather paspalum is practically dormant and that white clover gives the bulk of the feed obtainable, but with the coming of the warm weather paspalum becomes vigorous once more and tends to dominate the pasture. On paddock 3 it was found that the percentage cover of paspalum and white clover is on the average lower than for other paddocks. This is due to the effects of the heavy Japanese millet growth which was grown as a cover crop. All paddocks were showing practically 100 per cent. cover in December, 1936.

(iv) *Production of Milk and Butter-fat.*—Table 3 gives the quantity and cost of fertiliser for the production of butter-fat per acre for 1935 and 1936.

TABLE 3.

QUANTITY AND COST OF FERTILISER FOR PRODUCTION OF BUTTER FAT.

Year.	Lbs. Fertiliser used per lb. of Butter Fat produced.	Lbs. Super. applied per acre.	Lbs. of Sulphate of Ammonia applied per acre.	Total Fertiliser per acre per annum.	Total Expenditure.			Cost of—		
					For Super. per acre.	For Sulphate of Ammonia per acre.	For Fertiliser per acre.	Super. per lb. of Butter Fat.	Sulphate of Ammonia per lb. of Butter Fat.	Fertiliser per lb. of Butter Fat.
					s.	s.	s.	d.	d.	d.
1935	2·815	904	218	1,122	29·25	24·5	53·75	0·88	0·738	1·618
1936	0·786	374	28	402	12·47	2·48	14·95	0·29	0·06	0·35

Note.—Butter Fat produced :—1935 = 398·6 lbs. per acre : 1936 = 519·9 lbs. per acre.

It will be seen that the cost of fertiliser per lb. of butter-fat produced in 1935 was 1.618d., and for 1936 was 0.35d. The figure for 1935 approximates that obtained from the Better Dairying Competition for dry land conditions for 1934-35, shown in table 4 attached. In the case of the irrigated pasture the production was

398.6 lbs. of butter-fat per acre against 48.6 lbs. per acre in the case of the Better Dairy Farm Competition. The total amount of fertiliser used per acre was 1,122 lbs. in 1935 and 402 lbs. in 1936.

In 1936, 519.9 lbs. of butter-fat were produced with an application of only 402 lbs. of fertiliser.

The production of 6,793.5 lbs. of butter-fat and 13,018.4 gallons of milk from an area of 12.895 acres constituted at the time, a record for this State.

Table 4 gives the cost of fertiliser per lb. of butter-fat obtained under dry land farming in the Better Dairying Competition of 1934-35 and 1935-36.

TABLE 4.

QUANTITY AND COST OF FERTILISER FOR PRODUCTION OF BUTTER FAT UNDER DRY LAND CONDITIONS.

Year.	Lbs. of Fertiliser per lb. of Butter Fat produced.	Average Super. Applied.	Total Expenditure on Super. per acre.	Cost of Fertiliser per lb. of Butter Fat produced.
		lbs. per acre.	s.	d.
1934–35	3·70	179·8	6·66	1·683
1935–36	3·72	161·3	5·37	1·488

Table 5 shows production per acre of butter-fat and milk and also gives the cost of fertiliser per lb. of butter-fat produced for each paddock.

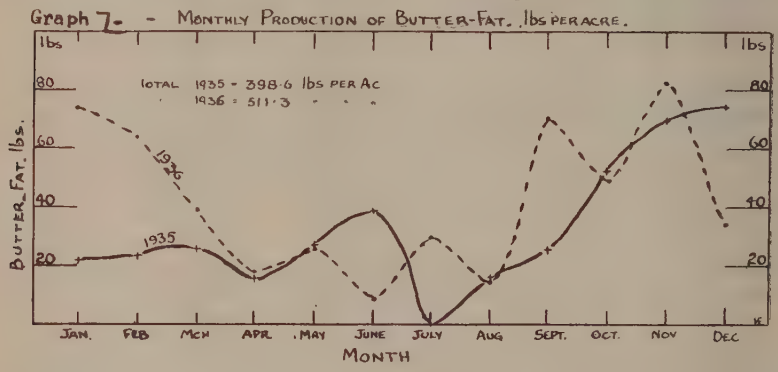
TABLE 5.

BUTTER FAT AND MILK PRODUCTION, 1935–1936.

Year.	——	Area.	Butter Fat.		Milk.		Fertiliser per acre.	Cost of Fertiliser per lb. of Butter Fat.
			Total.	Per acre.	Total.	Per acre.		
		acres.	lbs.	lbs.	gals.	gals.	lbs.	d.
1935	Paddock 1	2·880	935·624	387·03	1,950·795	788·20	1,122	1·64
	„ 2	2·750	1,062·005	349·82	2,008·792	730·47	1,122	1·64
	„ 3	2·650	946·156	357·04	1,996·166	753·27	1,122	1·81
	„ 4	2·560	1,154·895	452·90	2,396·592	939·84	1,122	1·42
	„ 5	2·470	1,042·809	422·19	2,180·861	882·94	1,122	1·53
	Total	13·210	5,141·50	....	10,533·206	....	....	....
	Average....	....	....	398·60	....	816·80	....	1·65
1936	Paddock 1	2·475	1,435·38	539·58	2,605·41	1,052·69	402	0·332
	„ 2	2·750	1,413·93	514·00	2,775·79	1,009·38	402	0·349
	„ 3	2·650	1,225·73	462·54	2,303·11	869·10	402	0·404
	„ 4	2·550	1,359·73	533·23	2,659·85	1,040·49	402	0·336
	„ 5	2·470	1,358·77	550·11	2,674·29	1,082·71	402	0·326
	Total	12·895	6,793·54	....	13,018·45	....	....	....
	Average....	....	....	....	....	1,010·87	....	0·349

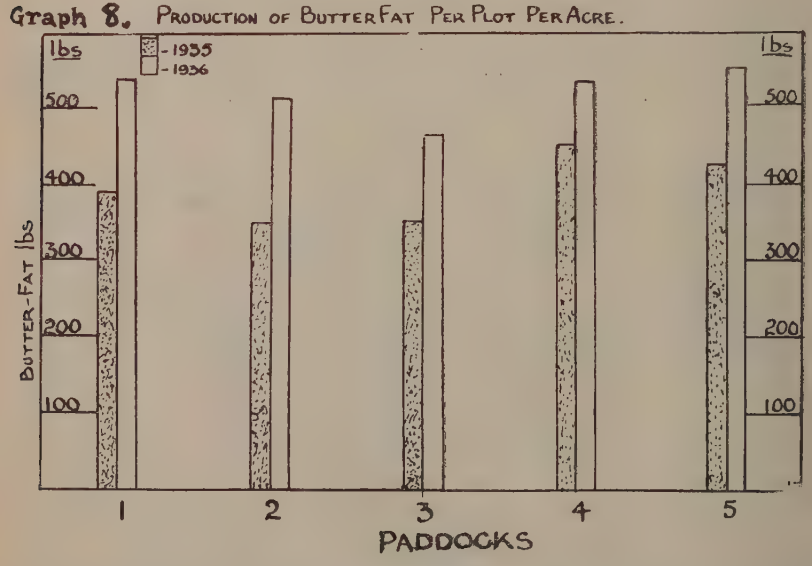
From this table, it will be seen that the effect of the cover crops on the growth of the pastures has been reflected in the production from each paddock. Thus in 1935, greatest production was obtained from paddocks 4 and 5 and in 1936, Nos. 5, 1 and 4 were superior. The cost of fertiliser per lb. of butter-fat figures are of course showing similar differences between paddocks.

The production of butter-fat during the 24 months of the 1935-36 period are given in graph 7.



It will be seen from this graph that production is mainly confined to the spring and summer months, but it is also evident that production has followed closely the grazing details. During 1936, the May production was relatively high, low in June, high in July, low in August, high in September, low in October and high in November. These results may be compared with the grazing results for the same year.

Finally the production of butter-fat per paddock has been given in graph 8 for the years 1935 and 1936.



This graph further demonstrates superiority of paddocks 4 and 5 in 1935 and of 1, 4 and 5 in 1936.

DISCUSSION.

Is it profitable to establish permanent pastures under cover crops?

The cover crops used in this trial were Sudan grass, Italian rye-grass, Japanese millet, and Perennial rye-grass, whilst on the control, no cover crop was grown.

Where Japanese millet and Italian rye-grass were used as cover crops, least grazing per acre was obtained (Table 1), and the lowest figures for butter-fat production per acre were obtained (see Table 5) during the establishment year 1935. This, too, in spite of the bulk of fodder produced by the cover crops themselves during the early part of the year. Of the two paddocks, that growing Japanese millet was somewhat more productive than the Italian rye-grass one. This is probably due to a slightly greater production of fodder from the Japanese millet as indicated by the depression in the percentage of white clover shown in the botanical analyses.

The effect of Sudan grass cover was not so serious as that of Italian rye-grass or Japanese millet, but it was of a similar nature. This is attributed to the partial failure of the Sudan grass cover crop which allowed white clover to make a partial establishment and some growth. Both the grazing figures (Table 1) and the butter-fat returns (Table 5) show that this paddock was superior to Nos. 2 and 3 during 1935.

Paddock 5 had no cover crop and gave higher grazing figures (Table 1) and higher butter-fat production (Table 5) than Nos. 1, 2, and 3. Paddock 5 was slightly inferior to No. 4 which grew a cover crop of perennial rye-grass during 1935.

During 1936, a somewhat similar set of results was obtained, but with some variation. The depressing effect of the Japanese millet and Italian rye-grass was still obvious but to a lesser extent than in 1935. The position of these two was now reversed and during this second year, the Italian rye-grass paddocks provided more grazing and produced more butter-fat per acre than did the one originally growing Japanese millet. This bears out the explanation given for the differences in carrying capacity and production during 1935. The botanical analysis showed that the greatest suppression of white clover occurred on paddock 3.

During 1936, the one which grew the Sudan grass cover crop maintained its position mid-way between paddocks 2 and 3 and paddocks 4 and 5.

Paddock 5 (no cover crop) provided most grazing and produced most butter-fat per acre in 1936. In this respect the positions of Nos. 4 and 5 were reversed. The reason for this has been the decrease in the content of perennial rye-grass in the pasture (see Graph 6). It was found that even in 1935, the percentage of white clover in No. 5 was greater than that in No. 4, and as the content of perennial rye-grass in the pasture decreased, then this superiority of white clover in the composition swung the balance in favour of paddock 5. On an average of the two seasons these two were almost equivalent in the amount of grazing provided and in the production of butter-fat per acre. The carrying capacity figures for the years 1937 and 1938, indicate that the introduction of perennial rye-grass into the paspalum-white clover pasture had a slight advantage, and that paddock 4 was slightly more productive of grazing than was 5.

Table 5 has been drawn up to show the cost of fertiliser per lb. of butter-fat produced. On paddocks 2 and 3, the cost during 1935 was 1.84 and 1.81 pence respectively, whilst on No. 5 (no cover crop) it was 1.53 pence. In 1936, the cost on No. 3 was 0.404 pence, whilst in No. 5 it was 0.326 pence.

Thus it is clear that with the exception of the addition of a small quantity of Perennial rye-grass it is unprofitable to establish permanent pasture under a cover crop even when the cover crop is of a semi-permanent nature such as Italian rye-grass. Even during the first year, the use of a cover crop was not profitable and where it is used in the establishment of Paspalum—white clover mixture, the cover crop has the effect of retarding the establishment of white clover. The unprofitable nature of this method of establishing the permanent pasture may be observed into the second and third years after establishment.

Botanical Composition.

Some mention has been made of the effect of the cover crops on the constituents in the pasture, but the results obtained enable a more complete picture to be drawn concerning the variation in the pasture species between June, 1935, and December, 1937.

Total Cover.—This cover measures the density of establishment of all species. The anlyses include all the sown species as well as others such as couch grass and any other weeds which may have made their appearance during the course of the trial.

Between June, 1935, and December, 1935, the average percentage cover on the complete trial was 90.7 per cent.

In June, 1935, the Japanese millet paddock was poorest with only 78.4 per cent. ground cover. On Nos. 2 and 4 the rye-grasses had persisted sufficiently well to obtain a 94 per cent. total cover. Paddock 1, on which the Sudan grass cover crop was a partial failure had 89 per cent. cover and the most complete cover of all was obtained on 5 (no cover crop) and here 96.8 per cent. of the ground was covered by the pasture.

During July, August, and September, the total cover on all paddocks had increased, but the increase was most rapid on Nos. 1, 3 and 5. By November all of them showed a total cover of over 96 per cent. Over the seven months during which the analyses were made 5 was superior in the average percentage of ground cover obtained.

During 1936, the total cover on all paddocks remained at a high level between 97 and 100 per cent., again the most consistent being 5. By the end of 1935, the sown species were beginning to overcome the effect of the cover crops and to occupy ground space which had previously been occupied by, or smothered by, the cover crops.

Paspalum.—The only paddock on which paspalum seems to have been depressed to any extent in June, 1935, was No. 2. On all others the percentage of paspalum in the sward approximated that on 5. On No. 2, however, the paspalum quickly recovered and by December the percentage of paspalum on this one was equal to that on the remaining four.

During 1936, the percentage of paspalum was similar over all paddocks and no depressing effects from cover crops could be observed.

White Clover.—The first botanical analysis was made in June, 1935, and showed a very marked effect of the cover crop on the establishment and growth of white clover. Where no cover crop was used, 34 per cent. of white clover was present in the pasture, whereas when a Japanese millet cover crop was grown, the percentage of white clover was only 1.4 per cent. Where Italian rye-grass and Perennial rye-grass were grown, the percentages were 3.5 per cent. and 4 per cent. respectively. On No. 1, 13 per cent. white clover is recorded because of the partial

failure of the sudan grass cover crop. The percentage of white clover in the pasture is thus inversely proportional to the density of the cover crop. By 1937, the effect of the cover crops had disappeared and the percentage of white clover was the same on all paddocks.

Rye-grasses.—The percentage of Italian rye-grass decreased from 26 per cent. in June, 1935, to 4 per cent. in December, and continued to decrease until only 1 per cent. of the pasture was Italian rye-grass in December, 1936. The rye-grass occupied some of the ground space in the early stages of the trial and as the percentage decreased, the white clover was allowed to establish itself. The percentage of perennial rye-grass declined from 37 per cent. in June, 1935, to 13 per cent. in December, 1935, and since that date, has remained fairly constant, having about 8 per cent. cover in December, 1936. From the grazing obtained from paddock 4 it would appear advantageous to add from 2 to 4 lbs. of Perennial rye-grass to the paspalum-white clover pasture at the time of seeding, but higher rates have a definite detrimental effect on the initial establishment of white clover.

During 1935 the Italian rye-grass on paddock 2 helped to obtain a percentage total cover of 94 per cent., whereas on No. 3, the percentage cover was only 78.4 per cent. Subsequent increases in plant cover from June, 1935, onwards, were least rapid on paddocks 2 and 4 owing to the decrease in the percentage cover of Italian rye-grass on No. 2 and Perennial rye-grass on 4. Once the percentage cover of these grasses reached a constant level the percentage total cover on all paddocks was the same.

Seasonal Behaviour of Species.

On all paddocks the Paspalum shows a summer incidence of growth whilst white clover predominates during the winter months. The behaviour of all species has been summarised in graph 6. From October to March, Paspalum dominates the pasture while white clover becomes dominant from March to October during the winter months. The rye-grasses which are also included in this graph show a well defined rise in percentage cover in the sward from August to October, the early spring period.

Grazing.

Analysis of the grazing results shows that for the years 1936 and 1937, great efficiency in grazing was not obtained on these paddocks. Consequently, the result of under and over-grazing shows up in successive seasons and in successive years. Heavy, close over-grazing during one month results in a scarcity of grazing during the next month, a heavy summer grazing is reflected in a low winter grazing and the poor grazing management of the 1936 seasons resulted in a decrease in the carrying capacity during 1937 and 1938. From this it can be seen that the correct grazing management of pastures is economically most important in obtaining the maximum production.

Grazing figures given in table 1 show that during the establishment year, 1935, the carrying capacity of the whole trial area was 1 cow to 0.97 acres. In that year, the best paddock was 0.85 acres per cow. During 1936, 1937, and 1938, the carrying capacity was 0.75 acres per cow. In this experiment the Jersey breed of cows was used throughout.

These three years, 1936, 1937, and 1938, represent the carrying capacity of the pasture as a permanent irrigated pasture and during this period, the carrying capacity of these pastures was one cow to 0.74 acres from the experimental area. For the best paddock during this period, the carrying capacity was 0.69 acres per cow. It has already been shown that the use of a cover crop has a depressing effect on the carrying capacity of these pastures and it is considered that paddock 5

is more representative of the actual carrying capacity of paspalum-white clover pasture under these conditions of grazing and climate. Over the three-year period paddock 5 carried one cow to 0.72 acres. Thus we have an indication that the carrying capacity of a paspalum-white clover pasture approximately averages one cow to 0.72 acres.

Over the remaining period of the trial a variation in the irrigation intervals on the various paddocks has occurred which introduces a new factor affecting the carrying capacity and will be dealt with under section B.

Yields.

From the yield figures obtained from the various paddocks (see graph 4) it is obvious that the use of the cover crops has had a determining effect on the yields of the various paddocks. Thus the yield on No. 5 was greater than that on any other in 1937 and 1938. The total recorded yields for this period indicate that the order of superiority was paddocks 5, 1, 2, and 3 and 4. This is in agreement with the grazing figures and serves to confirm the fact that with heavier cover crops there is a decrease in yield and best results have been obtained where no cover crop has been used.

Graph 2 showing the seasonal grazing agrees with a similar graph showing yields for the various seasons. The average yield of green material for the years 1937 and 1938 was 29.6 tons of green material per acre and during the same period the grazing figures indicate that one cow was carried to 0.74 acres. Thus for purposes of comparison one cow of the type used requires approximately the production of 21.9 tons of green material per annum.

Butter-fat Production.

The average returns of butter-fat per acre were 398.6 lbs. in 1935 and 519.9 lbs. in 1936. (See table 5.)

During 1935, the most economical returns were recorded for paddocks 4 and 5 which produced 452.9 and 422.2 lbs. of butter-fat per acre, respectively, at a fertiliser cost per lb. of butter-fat of 1.42d. and 1.53d., respectively. In respect to production per acre, paddock 1 produced 378 lbs. butter-fat per acre, No. 3, 357 lbs. per acre, and No. 2, 349.8 lbs. per acre. This confirms the results already given for the grazing obtained from each paddock.

During 1936, paddock 5 was the greatest producer with 550 lbs. butter-fat per acre. No. 1 produced 539.6 lbs. per acre, No. 4, 533.2 lbs. per acre, No. 2, 514.2 lbs. per acre, and No. 3 was lowest with 462.5 lbs. per acre.

As 1935 was the establishment year, the figures for 1936 may be taken to represent a closer approximation of the return from permanent pastures of paspalum-white clover under the conditions of irrigation, management, and climate already mentioned. The average return for 1936 was 519.9 lbs. of butter-fat per acre. Thus on these pastures the production per cow in this particular herd averaged 385 lbs. of butter-fat per annum.

The yield of green material in tons per acre for the months, July to December, 1936, was 10.3 tons per acre. The production of butter-fat over the same period was 284.5 lbs. per acre. Thus during this period, the return of butter-fat per ton of green material was 27.9 lbs.

POINTS ARISING FROM DISCUSSION AND RESULTS.

1. *Cover Crops.*

(a) It is not profitable to use any of the cover crops used in this trial to establish a pasture of paspalum and white clover under the conditions described with the possible exception of Perennial rye-grass which is of value when used at much lower rates of seeding, i.e., 2-4 lbs. per acre.

(b) The cover crops used did not materially influence the establishment and growth of paspalum dilatatum.

(c) The cover crops used had a profound effect in depressing the establishment of white clover.

(d) This depressing effect on white clover could be observed for a period up to two years after the establishment year 1935.

2. *Grazing.*

(a) The effect of over-grazing during one month results in a reduction of grazing during the succeeding month.

(b) Over-grazing during one season of the year results in a loss of grazing in the following seasons.

(c) Over-grazing during one year results in a decrease in carrying capacity in the following year.

(d) Correct grazing management is essential for best production.

(e) The carrying capacity of a paspalum-white clover pasture under the conditions described is approximately one cow to 0.76 acres.

3. *Yield.*

From the average yield obtained per acre per annum from this area, one grazing cow is equivalent in one year to 21.9 tons per annum of green material produced.

4. (a) Paspalum makes most of its growth during the summer months when it tends to dominate the pasture, but remains almost dormant during the winter months when white clover dominates the sward.

(b) On paddocks where rye-grasses were sown, the spring incidence of these grasses was observed.

5. (a) The average production of butter-fat during the establishment year, 1935, was 398.6 lbs. per acre, and this was produced at a cost of fertiliser per lb. of butter-fat of 1.618d. per lb.

During 1936, the average production per acre of butter-fat was 519.9 lbs. and this was produced at a cost of 0.349d. per lb.

(b) From the cows per acre figure used in this trial and the average butter-fat produced per acre per annum (during 1936) then the production per cow was 390 lbs. per annum.

(c) From the yield figures obtained during 1936, and the butter-fat production during the same period from Jersey cows, the return of butter-fat per ton of green material was found to be 27.9 lbs.

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Irrigation Interval Trial.

H. G. ELLIOTT, Agrostologist.
L. C. LIGHTFOOT, Agricultural Adviser.
F. E. RYAN, Field Technician.*

SECTION B.

INTRODUCTION.

The Collie Irrigation Scheme was designed originally for water to be supplied at monthly intervals based on observations of Paspalum dilatatum pastures under irrigation at Harvey.

However, improved pasture mixtures which included white clover (*Trifolium repens*) were adopted for the new perennial pastures being laid down following experiments carried out by the Department of Agriculture (Dr. Dunne).

This clover showed signs that it needed water at shorter intervals than one month, and as there was considerable diversity of opinion among the water users regarding the best interval between waterings, the Department commenced an Irrigation Interval Trial which by courtesy of the Australian Dairy Produce Board Pasture Improvement Committee (W.A.), and Mr. W. D. Moore was located on the Council's irrigated permanent pasture already discussed in Section A.

Aim.

The object of the trial was to test the effect of varying the time between waterings during the irrigation season.

Materials and Methods.

Pasture.

The previous history, botanical composition, and condition of the pastures is given in Section A of this report. By November, 1937, the pastures had become sufficiently constant on all five plots to enable this trial to be applied.

Soil.

A description of the soil type is given in Section A.

Irrigation.

The area varies from about 10 chains to 11½ chains in length and has an almost uniform fall from east to west of about one foot to the chain. (See Fig. 1, Section A.)

For the irrigation interval trial, a series of gauges for water measurement were installed by adapting certain of the existing combined stop and drop structures, and putting in a main gauge in the supply ditch in the race. The irrigation layout, structures, and measuring gauges were installed under the direction of Mr. H. K. Gibsone, (Assistant Officer in Charge, Irrigation). The plan, Figure 1, shows most of the details. The gauges used were rectangular contracted weirs.

A water requirement of 1⅓ acre inches a week was adopted for the purpose of the trial, and 2⅔ acre inches of water were to be applied on No. 3 fortnightly, 4 acre inches of water were to be applied on Nos. 2 and 4 three-weekly, and 5⅓ acre inches of water were to be applied on Nos. 1 and 5 fortnightly, so that the pastures would receive about the same amount of water per week. Table No. 6 shows the numbers of irrigations and the depth of water applied in inches in each paddock for the period of the Trial.

These details show that the desired amounts of water were not applied in the first irrigation season of the trial, 1937-38. This was due mainly to lack of familiarity with the irrigation of these paddocks and lack of control of the water

*Field Technician employed by A.D.P. Board Pasture Improvement Committee (W.A.).

TABLE 6.

TABLE SHOWING WATER APPLIED IN INCHES.

	Irrigation every 4 weeks.								Irrigation every 3 weeks.								Irrigation every 2 weeks.			
	Paddock 1.				Paddock 5.				Paddock 2.				Paddock 4.				Paddock 3.			
	37–8.	38–9.	39–40.	40–41.	37–8.	38–9.	39–40.	40–41.	37–8.	38–9.	39–40.	40–41.	37–8.	38–9.	39–40.	40–41.	37–8.	38–9.	39–40.	40–41.
No. of Waterings	4	5	6	6	4	5	6	6	5	6	8	8	5	6	8	8	8	9	12	12
Total Inches	18·9	14·72	17·30	17·89	25·0	27·56	29·39	29·36	30·3	24·13	27·01	29·17	34·9	24·31	30·46	31·03	41·9	23·89	30·62	30·36
Average per Irrigation	4·72	2·94	2·88	2·98	6·25	5·51	4·90	4·89	6·06	4·02	3·38	3·65	6·98	4·05	3·81	3·88	5·23	2·65	2·50	2·53
Average Inches per week	1·18	·72	·72	·74	1·56	1·38	1·22	1·22	2·02	1·34	1·13	1·22	2·33	1·35	1·27	1·29	2·61	1·33	1·25	1·26
No. of weeks Irrigated	12	18	20	20	12	18	20	20	12	16	21	21	12	16	21	21	14	18	22	22

due to a variable flow from the supply point, the bad condition of the irrigation furrows, and the frequent necessity for irrigating overnight when regulation of the water was inadequate.

Before the 1938-39 irrigation season the whole area was re-furrowed, arrangements were made giving a much more even flow of water at the supply point and the possibility of doing most of the irrigation during daylight. These alterations and the experience of 1937-38 enabled a general fairly close approximation of the desired irrigations to be made during the following three seasons of the trial.

Excepting for paddock No. 1, the probable reasons for which are considered later (see discussion) (see Table No. 6), some aberration occurred in the amount of the irrigations. This is generally due to normal unavoidable variations of flow at the supply point, occasional night irrigations, and the upset to irrigating caused by rain prior to or during irrigation.

The different water applications were made by varying the rate of flow on to the paddocks, a much higher flow of water being used for a much shorter time to apply $2\frac{2}{3}$ inches than to apply $5\frac{1}{3}$ inches, and by partially blocking furrows at suitable points so that a semi-flooding effect was achieved. In general about two-thirds to three-quarters of the ground surface was flooded, the remainder consisting of isolated small patches wetted by seepage.

Signs of drought were sometimes detected on small patches of pastures in No. 5, watered four-weekly, otherwise no reliable evidence of differences in the pastures were obtained by inspection, and the irrigation appeared to be adequate both in amount and in frequency.

Results.

Length of Irrigation Season.

In drawing up tables for comparing the results of various treatments, it has become necessary to define the limits of the irrigation seasons. Two methods of presenting these results are available.

1. The period between the date of the first watering and the date when the first effective rains made further irrigation unnecessary or when the influence of the last irrigation was judged to have ceased, may be taken. This is used in compiling Tables 8 and 9.

2. With intervals of 2, 3, and 4, weeks between waterings the date of irrigation of all plots in the series coincides at 12 and 24 weeks from the date of the first irrigation. At these times all plots have received equal total amounts of water for the period. As the season seldom continued as long as 24 weeks the 12 week period constitutes the most easily comparable record. This can clearly be seen by reference to Table 6. On this basis of a 12 week irrigation season, Table 7 has been drawn up.

Table 7 gives the yield obtained from each of the treatments in tons per acre of green material during the first 12 weeks of each irrigation season.

The yields for the 1937-38 season have been included in this table even though during that season the required amounts per irrigation were not applied. During that season however, the intervals between waterings of 2, 3, and 4 weeks were adhered to.

It will be seen that the average production from paddocks 1 and 5 was never greater than that of the average of paddocks 2 and 4, but that the individual production on each of these paddocks does show considerable variation. Paddock 3, is however, generally lower than Nos. 1, 2, 4, and 5, and the difference was becoming increasingly greater the longer the trial progressed.

TABLE 7.

YIELD IN TONS GREEN MATERIAL PER ACRE IN 12 WEEKS IRRIGATION SEASON.

Paddock.	1937–38.	1938–39.	1939–40.	1940–41.	1938–41 (Totals).
1	11·8	14·1	12·0	11·7	37·8
2	11·5	14·3	17·3	11·9	43·5
3	12·5	12·9	12·0	9·3	34·2
4	14·4	14·6	12·0	14·8	41·4
5	11·7	12·9	17·3	13·9	44·1
1 and 5	11·8	13·5	14·7	12·8	...
2 and 4	13·0	14·5	14·7	13·4	...
3	12·5	12·9	12·0	9·3	...

This tendency in the case of paddock 3 and the indecisive nature of the yields from the other four paddocks is repeated in Table 8 which shows the yields in tons of green material per acre during the effective irrigation season.

TABLE 8.

YIELD IN TONS GREEN MATERIAL PER ACRE IN EFFECTIVE IRRIGATION SEASON.

Paddock.	1937–38.	1938–39.	1939–40.	1940–41.
1	13·6	15·8	17·3	16·0
2	12·7	17·6	23·8	17·3
3	13·8	14·7	15·4	14·1
4	15·7	16·3	19·1	21·1
5	13·2	14·2	25·2	20·3
1 and 5	13·4	15·0	21·3	18·2
2 and 4	14·2	17·0	21·5	19·2
3	13·8	14·7	15·4	14·1
Effective Irrigation Season	15 weeks	17 weeks	25 weeks	24½ weeks

From this table it will be seen that even though in general the figures in both tables are comparable yet some variation is apparent in the comparative yields of long and short seasons. To obtain the comparative yields when a long and short season is used, Table 9 has been drawn up for the years 1939-40 and 1940-41, when both 12 and 24 weekly irrigation seasons were available.

TABLE 9.

SHOWING COMPARISONS OF YIELDS FOR 12-WEEKLY AND 24-WEEKLY IRRIGATION PERIODS.

Paddock.	1939–40.		1940–41.	
	12 Weeks.	24 Weeks.	12 Weeks.	24 Weeks.
1	72	68	84	80
2	100	96	84	90
3	72	64	63	70
4	72	76	105	105
5	100	100	100	100

In this table for purposes of comparison, the yields from paddock five are represented as 100 and corresponding figures used for the other paddocks.

Table 10 has been included to show the grazing obtained from each of the paddocks during the effective irrigation season. The figures shown are cow grazing days per acre.

Table 10.

GRAZING IN GRAZING DAYS PER ACRE IN EFFECTIVE IRRIGATION SEASON.

Paddock.	1937–38.	1938–39.	1939–40.	1940–41.
1	174·6	197·0	375·1	330·1
2	195·5	167·0	341·2	354·5
3	122·8	168·9	446·6	372·0
4	223·2	201·7	321·0	187·9
5	147·8	220·7	329·3	303·6
1 and 5	161·2	208·9	352·2	316·9
2 and 4	209·4	184·4	331·2	271·2
3	122·8	186·0	446·6	372·0
Effective Irrigation Season ...	15 weeks	17 weeks	25 weeks	24½ weeks

From these results it is obvious that there is a considerable discrepancy between the grazing and yield results which is so serious that it is obvious that no conclusions can be drawn from them.

DISCUSSION.

Length of Irrigation Season.

In choosing the length of the irrigation season the obvious method appears to be that outlined under (2). In these periods, in this case 12 and 24 weeks, all paddocks have received the same total amount of irrigation water. All paddocks too, have completed the allowed growing period since their last irrigation. For example, if the period were taken at 11 weeks instead of 12, all paddocks would have received the same total amount of water, but paddocks 1 and 5 would have had only three weeks' growth instead of four weeks from their last watering at the end of the season, paddocks 2 and 4 only two weeks' growth instead of three and paddock 3 only one week's growth from previous watering instead of two weeks. This does not give a satisfactory comparison since after the last irrigation on paddocks 1 and 5 the interval of one month from watering is not being measured. This condition is further exaggerated if 10 or nine weeks from the first irrigation is taken, since in that case all plots do not receive the same total amount of water during the irrigation season and the interval after watering is not preserved.

On the other hand the 12 weeks' irrigation period is not completely successful. The results obtained are representative of only a short period instead of the complete irrigation season. In this respect Table 9 has been drawn up for the seasons 1939-40, and 1940-41 to show the correlation between the 12 week period and the 24 week period.

The main differences are the same for the 12 weekly and the 24 weekly figures but there are some discrepancies which indicate that 12 weekly irrigation periods are probably not suitable indices of these results. For this reason then the effective period of irrigation which is limited at the commencement of the first suitable rain or by climatic factors such as cool and cloudy weather and heavy dews which are sufficient for the continued growth of the pastures will perhaps give better comparisons. This method suffers from the incompleteness of the watering details but has the advantage of a longer period over which results are taken.

Seepage on Paddock 1.

It was found impossible to apply water to paddock 1 at the desired rate. The soil as indicated by soil survey (Teakle) would normally absorb the desired amount of water. The failure to do so probably is due to underground seepage of water from higher levels. The topography (see Fig. 1) and the soil profiles of the southern half of paddock 1 indicate the bed of an old watercourse or creek (Teakle's soil survey). During the 1939-40 season paddock 1 absorbed nearly the desired amount in the February and March irrigations. This followed a wet winter in which the bulk of the rain fell in June, July and August. September was abnormally dry and the ground dried out very rapidly and irrigation in the area commenced two to three weeks earlier than the previous season. The irrigation season itself was very long and dry continuing for 24 weeks as against 17 weeks for 1938-39 and 15 weeks for 1937-38. This appears to support the theory of underground seepage. As this is probably the case then the results obtained from paddock 1 cannot be used as representative of the four-weekly watering interval.

Treatments.

During 1937-38 season paddock 3 appears to be inferior in yield to paddock 4, but superior to paddock 2. During the 1938-39 season it was somewhat inferior in yield to paddocks 2 and 4, in 1939-40 inferior to 2 and equal to 4, and in the 1940-41 season it was inferior to paddocks 2 and 4. During 1937-38 the same amount of water was not applied to all paddocks but for the last three seasons of the trial this was the case. Over the last three seasons the average total yield from paddocks 2 and 4 was 42.6 tons of green material per acre whilst the yield of paddock 3 was 34.2 tons of green material per acre. See Table 8. Therefore we have an indication that paddock 3 was inferior to paddocks 2 and 4.

In the same way for the last three years of the trial paddock 3 was somewhat inferior to paddock 5, the yields being 34.2 tons and 44.1 tons per acre of green material respectively. (See Table 7).

These figures are similar to those of Table 8.

There appears to be little difference between paddocks 4 and 5.

The yield results however are in contradiction to the grazing results shown in Table 10. Paddock 3 has carried most grazing over the experimental period and paddocks 2 and 4 the least.

Consequently very little can be gained from using either the yield or grazing results since it appears that paddock 3 was severely overgrazed, in which case its yield would be seriously decreased. If paddocks 2 and 4 were undergrazed then they could be expected to produce greater bulk of material.

The contradictory nature of these results rules out the possibilities of any conclusions being drawn apart from a possible indication that paddock 3 with two weekly waterings was inferior to the other paddocks. Although the trial has not provided any definite information as to the most suitable interval of irrigation, it has, however, been of much value in providing information to the effect that 4 inch waterings at three-weekly intervals will maintain growth with apparently high production, but with 5 1-3 inch waterings at four-weekly intervals wilting was observed during January and February prior to watering. As the average irrigation in the Collie River irrigation area varies from 7-12 inches the above figures are significant. It has also shown that the furrow system of irrigation leaves much to be desired, when attempting to water the whole area uniformly but valuable information was collected relative to methods of controlling amount of water per watering.

Further it must be pointed out that, although no definite conclusive information has been obtained, the trial shows the necessity for further more elaborately designed fully controlled experiments of a similar nature being carried out but under the border method of controlled flood irrigation.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made to Mr. A. R. C. Clifton, Officer in Charge, Irrigation Branch and his officer Mr. H. K. Gibsone for their general assistance and advice given during the period of the trial.

Subterranean Clover.

THE USE OF ULTRA-VIOLET LIGHT FOR STRAIN DETECTION.

G. R. W. Meadly.

SUMMARY.

The investigation was designed to ascertain the practical value of seedling examination under ultra-violet light for the segregation of subterranean clover strains.

Mixtures of the midseason and early (Dwalganup) strains were germinated and examined, along with controls of each. Although the general appearance of the controls was quite distinct, the final decision regarding some of the mixed seedlings, particularly those poorly developed owing to fungal or bacterial attack, was not easy to reach.

The seedlings were grown on and the strains determined from their vegetative and floral characters. An average of 1% of the early and 3% of the midseason strain were found to be wrongly classified.

After having examined seedlings of other strains it is evident that determination of actual strain by this means is difficult, if not impossible, and the value of the test is restricted to samples in which the strains present are known. Although these examinations may serve as a useful supplement to the method of subterranean clover seed certification in force, our present knowledge would not allow it to replace the system embodying field inspections in the growing period followed by supervision of harvesting operations.

1. INTRODUCTION.

In 1929 the late Dr. G. Gentner of the State Seed Control Station, Munich, published his findings that the roots of seedlings of Italian rye grass grown on white filter paper would bring about a condition in the paper which, when examined under filtered ultra-violet light would render it fluorescent, while the seedlings of perennial rye grass under indentical conditions would not. Since then a large amount of investigation has been carried out with the rye grasses, and also with other species of economic importance. Linehan and Mercer, of the Northern Ireland Department of Agriculture, found that the characteristic of fluorescence was associated not only with the annual species of *Lolium,* but also with the shorter lived perennial types termed pseudo-perennials. In recent years the fluorescence of germinating seedlings, particularly of rye grasses, has received the attention of many workers, and its practical value for segregating strains has been questioned.

The first reference to the use of ultra-violet light for detecting strains of subterranean clover was made by Trumble and Phipps (2) in 1933 when the following statement appeared in the *Journal for Scientific and Industrial Research*:—"During the course of the work various pasture species have been subjected, whilst germinating on filter paper, to the ultra-violet light test. It has been found that whereas South Australian commercial subterranean clover seed is non-fluorescent, an early flowering type from Dwalganup (W.A.), which is becoming increasingly important in the lower rainfall areas, is fluorescent. The fluorescence is, however, faint and unlike rye grass, the casual substance is confined to the root tissue and not exuded."

In 1934 the author (1) reported the following in the *Journal of Agriculture, W.A.*:—"Several different lines of Dwalganup, midseason (Mt. Barker) and Wenigup (late) strains of subterranean clover seed were germinated on moist Whatman filter paper, and each allowed to continue growth for the same length of time (four days and six days in the two series conducted). When these seedlings were viewed under screened ultra-violet light (4,000-5,000 angstrom units) from a mercury vapour lamp, a marked difference in the fluorescence of the three strains tested was noted. The fluorescing substance was apparently retained within the root, except for small amounts at the junction of the filter paper and the root apices.

Maximum fluorescence was obtained with the Dwalganup strain which produced a bright blue root colouration. The Wenigup gave a pale greenish blue, and the midseason was intermediate between the two."

In Western Australia the two strains, midseason (Mt. Barker) and early (Dwalganup) frequently form a mixed pasture, with varying proportions of the strains. Particularly in the midseason marginal areas these proportions may vary considerably from year to year, depending on seasonal conditions and other factors.

Subterranean clover seed production is quite an appreciable industry in this State and naturally seed gathered from mixed pastures cannot be expected to consist of a single pure strain. Most farmers, when purchasing, require a specific strain, but the seeds are practically identical and the slight colour variation is not sufficiently defined to allow segregation of a mixed line. There have been many costly experiences of midseason, or a mixture predominantly midseason, being sown in areas only suitable for early types. These have resulted from the farmer either not recognising the necessity to sow an early strain or not receiving the strain ordered.

To overcome the second difficulty a seed certification scheme was inaugurated in 1934, based on field inspections during the growing period, when the strains can be distinguished by vegetative and floral characters. If a means could be devised to differentiate between the strains by an examination of the seeds the cost of certification would be reduced considerably. A certain degree of segregation can be effected by using the colour of the seed coat as an indicator, particularly after the seeds have been moistened. Although quite useful at times this method is not reliable and may give misleading results. The investigation outlined in this paper was designed to ascertain whether examination of seeds or seedlings under ultra-violet light would prove of any practical value.

2. EXPERIMENTAL PROCEDURE.

Three lines of early (Dwalganup) and two lines of midseason seed were secured from Government certified areas previously examined during the growing period and located in the Narrogin, Boyup Brook, and Capel areas. These were mixed together in nine sets of pairs in proportions not known to the investigator. Two lots of 100 seeds of each mixture were placed on moist white filter paper. Following chilling for three days at 6° C., the germinating dishes were placed in an incubator at 20° C. The initial chilling induces rapid radicle development in the case of viable seeds which have a tendency to swell without further immediate signs of growth. As the appearance of the radicle is essential for this test, a high proportion of so-called semi-hard seeds is most undesirable.

Germination tests with duplicated controls representing one line of each strain were commenced at the same time and under the same conditions. These were taken from pure strain lines, which could be used for laboratory standard purposes if required.

After a period of four days the mixed samples were examined under ultra-violet light, using the controls for comparison. The early strain produced a bright

pale blue fluorescence extending along the entire root, while the roots of the mid-season were mainly dull grey in colour with traces of pale blue. This blue was seldom as conspicuous and bright as in the case of the early strain and at times was replaced by a pale violet tinge.

Seedlings considered to be the early (Dwalganup) strain by comparison with the controls were removed and placed on separate germinating dishes. At the end of six days a further examination was made and the remainder of the seeds which had produced radicles were segregated.

Although the general appearance of the controls was quite distinct the final decision regarding some of the mixed seedlings was not easy to reach. Little trouble was experienced with vigorous seedlings which had produced strong and well developed radicles, but weak seedlings, particularly when affected with fungi or bacteria, presented difficulties.

The seedlings from each separation were then carefully planted into seed boxes buried to ground level. Adequate waterings were provided and few losses were experienced, considering the weak growth of some of the seedlings. The plants were grown on until they reached a stage when the strains could be determined definitely from the leaf markings or the flower colour.

3. RESULTS.

The results of the segregations and growing on tests are listed in the following table:—

Sample Number.	Midseason Separation.	Number Planted.	Midseason Determined.	Early (Dwalganup) Determined.	Percentage Error.	Sample Number.	Early (Dwalganup) Separation.	Number Planted.	Early (Dwalganup) Determined.	Midseason Determined.	Percentage Error.
1a	43	43	43	0	4	1a	46	46	41	1	3
1b	53	53	49	4		1b	38	38	37	1	
2a	71	50	49	1	1	2a	23	23	22	0	0
2b	76	50	50	0		2b	24	24	21	0	
3a	70	50	48	1	1	3a	27	27	23	2	7
3b	71	50	50	0		3b	23	23	21	1	
4a	52	52	45	1	1	4a	41	41	24	1	2
4b	34	34	33	0		4b	50	50	42	0	
5a	63	50	47	0	0	5a	26	26	17	0	0
5b	63	50	49	0		5b	28	28	7	0	
6a	87	50	48	0	2	6a	10	10	10	0	5
6b	81	50	48	2		6b	11	11	10	1	
7a	62	50	47	1	1	7a	33	33	23	3	6
7b	65	50	46	0		7b	28	28	28	0	
8a	59	50	42	1	1	8a	30	30	25	0	0
8b	59	50	50	0		8b	33	33	29	0	
9a	75	50	47	0	0	9a	14	14	11	0	5
9b	85	50	47	0		9b	15	15	8	1	

4. DISCUSSION.

An analysis of the table discloses that, knowing the samples of seed examined consisted of mixtures of the midseason and early (Dwalganup) strains, it was possible to make an approximate segregation of the two strains. Of the nine mixtures examined the average error for the midseason separation was little more than one per cent., while for the early separation the corresponding figure was 3 per cent.

After having examined seedlings of other strains under ultra-violet light, it is concluded that determination of actual strain by this means is difficult, if not impossible, and the value of the test is restricted to samples in which the strains present are known. Although these examinations may serve as a useful supplement to the method of subterranean clover seed certification in force, our present knowledge would not allow it to replace the system embodying field inspection in the growing period followed by supervision of harvesting operations.

5. ACKNOWLEDGMENTS.

I wish to acknowledge the help of Messrs. R. D. Royce and K. Needham, Agricultural Advisers of the Department of Agriculture, who prepared the original seed mixtures and assisted with the "growing on" tests.

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Clean Milk Competition—Brunswick 1941-42.

V. WESTON, Dairy Instructor, Waroona.

Clean milk competitions have been conducted in various centres of the South-West for a number of years, dating from 1934. The results have been highly successful in improving the quality of milk intended for the manufacture of cheese and consumption as whole milk. Although a fine standard of efficiency resulted, there is still much room for progress. With this object in view Messrs. Browne's, Limited, of Brunswick, continued with their third competition in 1941, offering a trophy to the farmer producing the cleanest milk over a period of three months, November-January. In addition, a cash prize was given to the winner of each series of tests. Messrs. Elder, Smith & Co. also donated a prize to the winner of the entire series, appropriately 5 lbs. Zanic Steriliser and 28 lbs. Zanic Cleanser.

The allocation of points to determine quality was the same as used in previous competitions. Four series of tests were taken at intervals of approximately three weeks. All visits were of a surprise nature, so that previous preparation could not be made, and the samples taken were truly representative of the supply of each supplier.

The points allotted at each inspection were:—

Sediment	20 points.
Bacterial count	100 „
Total	120 points.

The following scale was adopted to determine the points for bacterial count:—

10,000	bacteria per C.C. and under	100	points
10,000	„ to 31,000	95	„
31,000	„ to 100,000	90	„
100,000	„ to 310,000	80	„
310,000	„ to 1,000,000	70	„
1,000,000	„ to 3,100,000	50	„
3,100,000	„ to 10,000,000	25	„
	Over 10,000,000	0	„

At the same time a catalase test, a reductase test, and a cell count were undertaken to obtain further information. The catalase test is used to denote the approximate number of leucocytes or white blood corpuscles present in milk. These are normally in milk, but the number increases at the beginning and towards the end of the lactation period, and is still higher in cases of udder disease or injury. Therefore, it is a valuable test for detecting the presence of Mastitis. In the reductase test the methylene blue decolorises in proportion to the number and growth of certain species of bacteria present when the milk is held at a suitable temperature. This test is commonly used in cheese factories and is a fairly reliable guide of keeping quality. The cell count is a microscopic count of the leucocytes present.

Samples were taken on the following dates:—October 29th, November 19th, December 10th, 1941, and January 6th, 1942.

The individual scores of the competitors are shown in Table I.

TABLE I.

	1st (29th Oct., 1941).			2nd (19th Nov., 1941).			3rd (10th Dec., 1941).			4th (6th Jan., 1942).			Total Points.
	S.	B.	T.	S.	B.	T.	S.	B.	T.	S.	B.	T.	
Carroll, W. J.	18	90	108	18	100	118	18	100	118	18	100	118	462
Simpson, A.	13	95	108	18	100	118	15	100	115	13	100	113	454
Warburton, A. S.	14	90	104	13	90	103	15	100	115	10	100	110	432
Reeve, F.	12	95	107	15	100	115	5	80	85	10	100	110	417
No 5	16	100	116	17	90	107	14	70	84	8	100	108	415
„ 6	15	95	110	12	80	92	12	95	107	9	95	104	413
„ 7	5	90	95	14	100	114	13	70	83	18	100	118	410
„ 8	15	100	115	12	100	112	8	50	58	16	100	116	401
„ 9	14	95	109	14	80	94	16	80	96	9	90	99	398
„ 10	15	100	115	12	80	92	3	70	73	16	100	116	396
„ 11	13	80	93	12	100	112	15	50	65	13	100	113	383
„ 12	9	90	99	12	70	82	12	80	92	12	80	92	365
„ 13	12	100	112	17	80	97	18	50	68	14	70	84	361
„ 14	0	100	100	5	100	105	3	50	53	2	100	102	360
„ 15	15	100	115	13	80	93	8	50	58	10	80	90	356
„ 16	9	50	59	12	100	112	12	70	82	0	70	70	323
17	14	80	94	15	100	115	13	50	63	13	25	38	310
„ 18	10	80	90	13	50	63	16	50	66	17	70	87	306
„ 19	16	70	86	14	50	64	13	50	63	10	70	80	293
„ 20	13	70	83	5	70	75	11	50	61	10	50	60	279
„ 21	14	90	104	12	95	107	13	25	38	3	25	28	277
„ 22	10	80	90	13	25	38	12	70	82	9	50	59	269
„ 23	5	70	75	5	70	75	11	25	36	12	25	37	223
„ 24	13	50	63	5	25	30	12	25	37	5	50	55	185
„ 25	12	50	62	14	25	39	18	25	43	5	25	30	174
„ 26	0	0	0	0	25	25	3	25	28	0	0	0	53

S.—Sediment. B.—Bacteria. T.—Total Points.

In assessing the results it must be borne in mind that the bacterial count was not begun until at least twenty-four hours after the sample was taken, as this work was performed in the Department's Perth laboratory. However, the sample was immediately packed in ice, and was kept in a chilled condition until examined.

From the outset a high standard was achieved and maintained throughout the series, except on one occasion when the average result declined, probably due to the adverse weather conditions prevailing at the time.

A summary of Table I is arranged in Table II showing the number of suppliers gaining maximum points for bacterial content, and the average score of competitors; together with the averages of the competitions held at this factory during 1940-41 and 1938-39. A glance at these figures will reveal the remarkable improvement in quality gained. The sediment test figures are not shown, as the improvement is only slight.

TABLE II.

	Tests.			
	1st.	2nd.	3rd.	4th.
Number of supplies to gain maximum points for bacteria	6	9	3	10
Average score of remainder to gain maximum points for bacteria	71	60	52	58
Average of all supplies to gain maximum points for bacteria	81	76	60	75
Average of all supplies to gain maximum points for bacteria, 1940–41	14	24	54	...
Average of all supplies to gain maximum points for bacteria, 1938–39	44	50	53	57

No suppliers gained maximum points for bacteria in the 1940-41 1938-39 series.

The results of the reductase tests are given in Table III attached. In all cases where decolorisation occurred under five hours the milk showed a very high bacterial count. Those under three hours averaged 10,000,000 bacteria per c.c. and those over three hours, but under five, contained an average of 5,600,000 bacteria c.c.

TABLE III.

REDUCTASE TEST.

	Hours.									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10 and over.
Test No. 1	1	...	...	...	1	1	...	...	8	16
„ 2	...	2	...	2	...	...	4	...	3	16
„ 3	1	2	...	...	...	3	5	6	2	6
„ 4	2	1	...	2	1	1	...	3	...	15

Hand and machine produced milk were on almost equal terms as regards bacterial content, but the machines showed to advantage by taking the first four places in the final results, followed closely then by two hand milkers. Therefore, it is clearly demonstrated that with proper care and attention and the cleaning of the machines by the boiling water-caustic soda method, milk of equal quality with the cleanest hand-milking can be produced. As regarding Mastitis

indication by the catalase test, the hand milking gives a closer reaction to normal than the machine milking: 65 per cent. of those showing a normal reaction being hand milked.

An examination of the sediment wads revealed that hair, feed, dung, flies, pus, cinders and soil particles were present. Considerable improvement could be effected in this direction by the use of better straining methods, close attention to minimising the prevalence of chaff, manure and soil dust in and about the cow shed, thorough rinsing of all utensils including milk cans, in boiling water, thorough washing of cows' udders and cooling the milk in a draught free room.

The three leading competitors have set an excellent standard by consistently producing a high grade article, despite adverse weather conditions experienced. They were closely followed by a number of others, eleven of whom for one or more tests gained maximum points for bacteria content. Therefore, it is not unreasonable to expect still further improvement in the future, provided the elementary details of cleanliness are strictly observed, such as—clean, healthy cows, washed udders, clean and dry hands, thoroughly washed milking machines, clean bails and yards, ample boiling water, and above all sterile utensils.

Studies in Sheep Husbandry in Western Australia.

III. Attempts to Influence Artificially the Breeding Season of British Breed Ewes.

E. J. UNDERWOOD and F. L. SHIER.

The reproductive life of the ewe, as with the females of other species, can be divided each year into breeding and non-breeding seasons. In the former, the ewes normally come into oestrus (heat) regularly at about 17-day intervals, with each heat period lasting about 30 hours. During the non-breeding season (anoestrum), which in most breeds lasts for several months, the ewes do not come into oestrus and will not take the ram. Throughout the agricultural area of Western Australia merino and merino cross ewes normally come into season, i.e., their "heat" or oestrus periods commence by December or January. This means that lambing begins in April and continues during May and June. This is very satisfactory from the point of view of the ewe and the suckling lamb since the best nutritive and grazing conditions are available during the period when they are most needed. With the British breeds in this State, with the exception of the Dorset Horn, on the other hand, it is consistently claimed by breeders that the ewes rarely commence their sexual season before February and that March and April are the months of most intense "heat" incidence. Most of the lambs in these breeds are therefore born in August and September and in consequence their suckling period, particularly during the latter half, is one of a falling plane of nutrition when the grazing is drying off and becoming reduced both in quantity and quality. Moreover, weaning takes place in late summer, the worse part of the grazing season. Unless very costly supplementary feeding is resorted to, over a period of several months, good growth in the young ewes and rams is impossible to obtain; their development is retarded and their usefulness as breeding animals delayed. This is a considerable handicap to the breeders of the British breed animals, and is also of great importance to the export lamb industry as a whole, since these animals play an essential part in the production of high quality lambs. Any means of bringing these ewes into season two or three months earlier, and hence having

lambs born at such time that the lambs and their mothers are able to take advantage of the best grazing period of the year would represent an important and valuable contribution to sheep husbandry in Western Australia. The use of certain commercial preparations for which gonadotrophic (sex-gland stimulating) properties are claimed seemed a likely possibility in this connection.

That the sex-glands (gonads) control the sexual processes has been known for a long time, but the discovery that these glands are themselves controlled by the activities of another gland, the anterior pituitary, has only comparatively recently been made by scientists. Surgical removal of the anterior pituitary gland from an animal has been shown to cause the cessation of reproductive activity. Conversely, injection of extracts of the gland into animals with their pituitaries removed or with their reproductive organs quiescent (as in ewes during anoestrum) has resulted in stimulation of the sex-glands (gonads), particularly the ovary. These findings have opened up great possibilities in the artificial control of the sexual processes—possibilities which have been increased by the further finding that, in addition to the pituitary gland itself, the blood serum of the pregnant mare during the third month of pregnancy and human pregnancy urine are rich resources of gonadotrophic (gonad-stimulating) material. A number of commercial preparations from these sources are now available and investigation of their effect on different animal species has been carried out in different parts of the world.

Cole and Miller (1933) appear to have been the first to have successfully used such a preparation in artificially inducing oestrus or "heat" and ovulation in ewes. These workers used injections of pregnant mare serum on groups of Romney and Shropshire ewes. Single injections produced ovulation, but not oestrus, but two doses at 16-day intervals, resulted in a high proportion of ewes showing heat, as well as ovulation, shortly after treatment. Later work (Cole and Miller, 1935) extended and confirmed these findings, but no success in initiating the sexual season was obtained. That is, a second oestrus did not follow an induced oestrus if the injections were discontinued. McKenzie and Bogart (1935) were able to induce oestrus in 70 per cent. of ewes injected with pregnant mare serum or with Antuitrin-S (a pregnancy urine preparation), compared with 35 per cent. in untreated ewes. McKenzie and Terrill (1937) were only successful in inducing oestrus in 23 out of 52 ewes given one large single dose of another preparation known as Progynon-B. Roux (1936) was completely unsuccessful in inducing oestrus in merino or merino-cross ewes, even by two injections at 17-day intervals of a standardised anterior pituitary hormone preparation known as Prolan. The doses used by this worker were comparatively small, however. O'Neal (1938) claimed that single injections of a pregnancy mare serum preparation (Gonadin) into a group of 430 ewes resulted in a 20 per cent. increase in number of ewes lambing, a shorter lambing season and a greater number of twins. Treatment of similar group of ewes under the same conditions with two doses at 16-day intervals, on the other hand, resulted in no increase in the number of ewes lambing or shortening of the lambing season, compared with untreated control ewes. More recently Bell et al (1941) were regularly able to produce ovulation but not oestrus, in ewes by the use of either pregnant mare serum or anterior pituitary extract. Five out of eight ewes treated with large doses of Progynon-B, however, were brought into oestrus.

The only Australian work along these lines so far as is known is that of Kelly and Shaw (1939). These workers produced oestrus in 21 out of 27 ewes treated during anoestrum with large doses of Progynon-B. Similar ewes treated with another gonadotrophic preparation (Antuitrin-S) showed no such evidence of "heat," as judged by the behaviours of the ram, irrespective of total dose or rate of administration.

From the above brief account of investigations carried out elsewhere it is obvious that the problem of inducing oestrus or "heat" in ewes during anoestrum by the injection of gonadotrophic preparations is neither simple nor clear cut. Nevertheless, there is ample evidence that such preparations can, under some conditions, be used with a considerable degree of success for the purpose. It is the object of this paper to describe experiments on this point with British breed ewes in the agricultural areas of Western Australia. A small preliminary experiment designed to test the value of such a preparation in increasing the lambing percentage to Border Leicester x Merino ewes, is also described.

RESULTS.

1940 *Experiment.*

Early in January, 1940, representative ewes from five different British breed studs were injected subcutaneously with a single 5 cc. (250 R.U. (Rat units)) dose of "Gonadin" as recommended by the makers (Cutter Laboratories, Berkeley, California). "Gonadin" is a gonadotrophic preparation from pregnant mare serum reputed to contain 50 R.U. per cc. The different breeds treated were as follows, the figures in brackets indicating the number of ewes treated:—

At York (60 miles east of Perth) English Leicester (46) and Southdowns (31); at Chittering (50 miles north-east of Perth) Border Leicesters (40); at Moora (120 miles north of Perth) Southdowns (54); at Upper Swan (20 miles north-east of Perth) Ryelands (25). After treatment the ewes, together with appropriate numbers of untreated ewes in each case as controls, were run with entire rams. At Chittering and Moora "hand" service records were kept as well as lambing details, but at York and Upper Swan the latter particulars only were obtained. The results of these exploratory trials were entirely negative and clearly showed that single 5 cc. injections of "Gonadin" had no effect in causing the ewes to breed earlier than the untreated controls. An odd ewe lambed in both treated and untreated groups at all centres in June (corresponding with a service in January), but the main lambing was during the last half of July and August. This is the usual period for such breeds and indicates that the ewes were in anoestrum at the time of the treatment.

1941 *Experiments.*

This season's experiments were confined to one centre (the Avondale Research Station, Beverley), and to one British breed (English Leicester), but two injections at 16-day intervals as suggested by Cole and Miller (1935) and greatly increased size of doses were used. In addition, the effect of a single injection of serum ("Gonadin"), given two to five days before oestrus, in producing multiple births, was tried on maiden Border Leicester x Merino ewes, following the suggestion of Parkes and Hammond (1940), and the experiments of Lopyrin (1937).

In the first experiment 45 stud English Leicester ewes, 4-tooth to full mouth, all of which had produced lambs during the previous season, were divided into four groups of similar age distribution. These groups were treated as follows:—

Group I. 15 ewes—controls, untreated.
Group II. 10 ewes—Two injections of 250 R.U. at a 16-day interval.
Group III. 10 ewes—Two injections, first 250 R.U., second 500 R.U. 16 days later.
Group IV. 10 ewes—Two injections, first 500 R.U., and second 1,000 R.U. 16 days later.

The first injection was given on 28/10/41, and the second on 13/11/41. The onset of oestrus was tested by the use of vasectomised or jacketed rams, raddled on the brisket, as described by Kelley (1937).

The first oestrus observation was on 14/11/41, one day after the second injection. During the following seven days, i.e., until 21/11/41, the oestrus incidence in the groups was as follows:—Gr. I., 1; Gr. II., 2; Gr. III., 3; and Gr. IV., 7.

From that date until February, 1942, with the exception of those mentioned in a subsidiary experiment, the only "heat" observations which were recorded were two in Gr. I. and one in Gr. II. It is apparent that the bulk of the ewes were in anoestrum during this period, and that only very heavy doses of this preparation were effective in inducing oestrus (70 per cent. success in Gr. IV.).

Following the November observations eight of the ewes were given a third injection of 1,000 R.U. 17 days after the previous oestrus. Of the eight so treated four showed oestrus within three days but only two of these conceived to raddled, entire English Leicester rams which were run with the flock during this time.

The lambing results of the flock were as follows:—35 ewes lambed corresponding to a mating period of the end of February and March; four died, two in March and two in lamb at the end of July; five lambed early in May and one ewe showed no oestrus at all.

In a further experiment in 1941 the value of the gonadotrophic preparation in increasing lambing percentages by reinforcing normal oestrus was tried. A number of raddled vasectomised rams were run with a flock of 150 Border Leicester x Merino maiden 18 months old ewes. From this flock 40 ewes were selected which showed oestrus (for the first time) and therefore could be expected to come into season again on known dates. These were divided into two groups by alternate drafting. Each ewe was injected subcutaneously with 250 R.U. of "Gonadin" two to five days before the second expected oestrus. The second group received no treatment. Both groups were then run with four raddled entire Southdown rams, and with one exception in Gr. I., all the ewes showed service with the entire ram at about the expected date. The rams were left with this flock for approximately two months, although no records were kept of later services.

The lambing records are summarised in tabular form below:—

	Group I.—Treated.	Group II.—Controls.
Number of ewes in group	20	20
Number of ewes lambing corresponding to date of first service ..	8	7
Number of pairs of twins	2	0
Number of ewes in lamb to later services	3	1
Number of ewes which did not become pregnant	9	12

The very low proportion of conceptions resulting from mating in these maiden ewes is difficult to explain, although infertility in the rams can hardly be the cause since, in addition to the four rams first used, a further six rams from those used successfully with the rest of the flock, were run with the experimental ewes. Such maiden ewes have normally a lower fertility than older animals, but whether to the extent shown in the experimental groups is not at present known. The occurrence

of two pairs of twins in the treated group, compared with none in the controls, is interesting and suggestive, but no more than this can be said in view of the comparatively small number of ewes, in either group, which became pregnant at all.

DISCUSSION.

The results show quite clearly that single doses of a commercial gonadotrophic preparation of pregnant mare serum reported to supply 250 rat units, which is the amount recommended by the makers, had no effect in inducing oestrus during anoestrum in either English Leicester, Border Leicester, Southdown, and Ryeland ewes. Even with two such doses at 16-day intervals, or with double the dose at the second injection, no success was obtained with English Leicester ewes during anoestrum. With two very heavy doses (500 and 1,000 R.U.), 70 per cent incidence of oestrus was induced, and a third injection of 1,000 R.U. produced a 50 per cent. response.

These results, although quite uneconomic at the present time for all ordinary sheep, are encouraging in that positive responses have been obtained, giving promise of considerable practical importance of such treatment in the animal husbandry of the future. Very little more than this can be said of most of the experimental data with sheep in this field. This is very apparent from the highly variable and even contradictory results of other experimenters, as described in the introduction. How far these results are due to difference in the nature and the potency of the various commercial and laboratory preparations used and how far they reflect inherent differences in the animals themselves or their environmental conditions it is impossible to say at the present time. Intensive work on the fractionation and purification of the different hormones of the pituitary and of the blood and urine during pregnancy, and of the factors which influence their biological behaviour is now under way in many laboratories and is the subject of considerable dispute. It would be out of place to attempt to evaluate this work here, but until further progress has been made along these lines, and in the times and rates of dosage and on the effect of varying conditions of storage and transport, it is felt that recommendations to farmers to use commercial gonadotrophic preparations may do more harm than good by bringing into disrepute products which, under the proper conditions, may prove exceedingly valuable to them. This applies particularly to their use with sheep, which do not appear to respond as satisfactorily as other species to treatment with gonadotrophic preparations. We have no evidence of our own on this point but it is apparent from the literature and also from the work of Cole and Miller (private communication). These workers have had difficulty with the British breeds of sheep with the same preparations which readily induced oestrum in pigs, cattle, and horses. This represents a challenge to research workers in this field which should be taken up vigorously since the possibilities of improved sheep husbandry through the solving of this and allied problems seem very great.

These remarks apply with equal force to the problem of improving lambing yields by the use of gonadotrophic preparations. The present small experiment on this problem was not a success but it should be stressed that the results apply only to Border Leicester x Merino maiden ewes, to one commercial preparation and to one period and rate of dosage. These conditions seemed the most worthwhile trying from the evidence available to the authors at the time, but modification of any one of them might result in improvement. Thus Loginova and Lopyrin (1938) produced multiple ovulations and a considerable increase in fertility in ewes, with the birth of quadruplets and quintuplets, by giving a second serum of pregnant mare serum at the onset of oestrus as well as the one given 2-3 days

earlier, as had been done in previous experiments. If the timing and size of doses could be so arranged to produce a high proportion of twins a very great increase in efficiency of lamb production would result, especially if the nutritive condition of the ewe immediately prior to as well as after lambing is maintained at a high level so as to insure maximum birth weight and growth rate of the lambs. Very encouraging results on this latter aspect of sheep husbandry have already been obtained by the authors under Western Australian conditions, and will form the subject of a subsequent publication.

SUMMARY.

A problem of late lambing of British breed ewes in the agricultural areas of Western Australia has been shown to be due to the failure of such ewes to come into oestrus or "heat" and attempts to bring such ewes into season earlier, by treatment with a commercial gonadotrophic preparation of pregnant mare serum ("Gonadin"), are described.

Single doses reported to supply 250 R.U. has no effect in inducing oestrus ("heat") during anoestrum ("off-heat") in either English Leicester, Border Leicester, Southdown or Ryeland ewes.

Two such doses at 16-day intervals or double this dose at the second injection were also unsuccessful with English Leicester ewes during anoestrum. Two very heavy doses (500 and 1,000 R.U.) at the same interval induced a 70 per cent. incidence of oestrus and a third injection of 1,000 R.U. 50 per cent. incidence.

An attempt to improve fertility, by producing multiple births, in a group of 20 maiden Border Leicester x Merino ewes, by an injection of "Gonadin" two to five days before a normal oestrus, was unsuccessful and inconclusive due to an exceptionally low proportion of pregnancies resulting from mating.

The significance of these results is discussed in relation to those of other workers and the importance is stressed of further work in this field, particularly with sheep, before general recommendations to farmers are made.

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Fertilisers for Potatoes in Wartime.

A Review of Potato Experiments carried out in Western Australia, 1922 to 1942.

L. J. H. TEAKLE,* G. H. BURVILL,† and E. T. MORGAN.‡

SUMMARY.

1. Twenty-three experiments with fertilisers for potatoes have been carried out in the 1922-1942 period.

2. The results show that, for potatoes in Western Australia grown under a variety of soil and climatic conditions, on the average the most profitable fertiliser dressing per acre is a mixture supplying

2 cwt. of sulphate of ammonia (20.5% N.).

8 cwt. of superphosphate (22% P_2O_5).

1 cwt. of sulphate of potash (48.6% K_2O).

There is no certainty that heavier dressings will give higher yields.

3. In wartime, with all fertilisers in short supply, it is more efficient, nationally, to use lower rates per acre, than to reduce the number of acres to which the available fertiliser is applied.

4. Experiments to determine the best rates of fertiliser for any crop must be suitably designed if the meaning of the yield differences between the treatments is to be properly interpreted.

INTRODUCTION.

1. *The Wartime Problem.*

Wartime conditions have seriously interfered with supplies of all common fertiliser ingredients of paramount importance for many Western Australian crops. It is the problem of the agricultural administrators to make use of available supplies with the highest degree of efficiency to secure maximum production of the most important agricultural commodities needed by the fighting forces and the civilian population. To that end, the results of some 23 fertiliser experiments with potatoes carried out in Western Australia over a period of twenty years have been carefully examined. The conclusions to be drawn are stated and discussed in this paper.

In the appendix information regarding wartime policy with respect to fertilisers in Great Britain is given for the information of those interested.

2. *Use of Fertilisers.*

It is natural that farmers should desire maximum returns for their labour and investment and, in consequence, are anxious to ensure adequate fertiliser applications to meet the needs of the crops growing on their farms. Of course, it must be realised that the production of crops depends on a large number of factors of which the fertiliser dressing is only one. The most important of these factors include climate, soil type, soil preparation, fertiliser practice, maintenance of organic matter, crop rotation, disease control, selection of suitable varieties, proper

*Plant Nutrition Officer. †Assistant Plant Nutrition Officer. ‡Officer-in-Charge, Potato Branch.

planting time, as well as constant attention throughout the growing period and proper handling at harvest time. Faulty practice with respect to any one of these factors may mean reduced crop production—perhaps failure.

The fertiliser programme is only one factor and the most competent farmers give due attention to all other factors as well. Perhaps they are generous, even over-generous, in their care in all operations and allow a big factor for safety in their efforts to secure large crops of high quality. This would apply particularly to crops of high money value per acre. For instance, most Western Australian farmers use large amounts of mixed fertilisers with their potato, vegetable, tobacco, and similar crops.

But the most successful farmers are probably just as generous in their attention to other factors and it is impossible to conclude that their success in crop production is solely due to fertiliser practice. It would be just as illogical to ascribe the success of a master painter, for instance, to the brand of paints he selected for his work.

The fertiliser dressing which should be aimed at is that "which gives the maximum financial return after allowing for the cost of the fertiliser and any additional costs resulting from the larger crops." This is the most efficient application and is known as the "optimal" dressing (Crowther and Yates (1941)).

What is the optimal fertiliser dressing for the potato crop under average conditions in Western Australia?

Some indication of the answer to this question is given by the experiments carried out by the Department of Agriculture. These experiments were started in 1922 because of growers' concern over the increasingly heavy fertiliser costs which had to be met by the industry. In the early history of the industry, fertiliser applications are reported to have amounted to about 7 cwt. per acre, but by the early 1920's many growers considered it necessary to use from 15 to 20 cwt. per acre to obtain satisfactory yields.

Mr. P. J. Wicken, then attached to the Department of Agriculture, made inquiries into the matter and as a result a committee was formed to undertake experiments with potatoes in the coastal plain country between Perth and Bunbury. The experimental programme was commenced in 1922 and has been continued until the present time and extended to other districts as far as facilities and staff have permitted.

3. *The Interpretation of Experimental Results.*

Before attempting to consider the experiments, it is necessary that the requirements for sound experimentation and points to be observed in the interpretation of the results be clearly understood.

First of all, it must be realised that two plots of potatoes or any other crop, even if lying adjacent and on land appearing perfectly uniform to the eye, will rarely give the same yield although all practical treatments have been identical. Differences between such apparently uniform plots are commonly as great as 20%, and sometimes more. This is due solely to the variability of soils and other factors affecting crop yield which cannot be controlled under ordinary field conditions.

The position may look hopeless, as any experiment liable to an error of two tons of potatoes in a 10 ton crop would not be considered of much use to a farmer, as about £20 per acre may be involved. This finding emphasises the fact that the ordinary type of experiment carried out by farmers in which one half of a paddock receives one treatment and the other half another is unlikely to

be conclusive unless the difference in effects is very great. Similarly, giving a strip through a paddock a different treatment from the rest is not going to be of much value unless very substantial differences are obtained. Further, it will be readily understood that comparison of results from a certain treatment in one year with another treatment in some other year will be quite impossible.

The position is not hopeless, however, but necessitates very carefully planned experiments. These involve repetition of the treatments under consideration and proper layout of the plots. This enables a more reliable estimate of the treatment yields to be obtained and, in addition, the "natural" variability of the experimental area can be calculated. When this natural variability of any experimental area is known, the meaning of the differences between the treatments can be gauged.

In a single experiment, of the type generally adopted in Western Australia with fertiliser treatments for potatoes, the variability due to uncontrolled effects is usually such that, to be considered real, a difference of about 10% between the results of the treatments is necessary. Unless such a difference is obtained one cannot be reasonably certain that the effect is due to the treatment in question and not to the interplay of other factors. The many apparently anomalous results in tables A, B, and C of Appendix 1 will illustrate the need for this caution in interpretation of yield data even from carefully controlled experiments.

The repetition involved as a result of the 23 separate experiments makes it possible to draw conclusions from much smaller differences. Even so, differences of less than two or three per cent. in the averages of these experiments are not likely to be significant.

THE EXPERIMENTS.

The first experiments were designed chiefly to determine the value of lime for the potato crop, as at that time soil acidity was thought to be of paramount importance in crop production. However, the degree of acidity in the soils under investigation was favourable for potatoes and the effect of lime was negligible.

Experiments with respect to the various fertilisers were designed to determine the effect of varying the rate of application of each ingredient when the others were supplied in adequate amounts. Ranges adopted for the ingredients were:—

Sulphate of ammonia	nil to 6 cwt. per acre.
Superphosphate	nil to 17 cwt. per acre.
Sulphate of potash	nil to 4 cwt. per acre.

In one experiment under winter conditions top dressing with sulphate of ammonia at emergence was investigated.

In most of the experiments the treatments were compared with a standard fertiliser mixture consisting of 4 cwt. of sulphate of ammonia, 12 cwt. of superphosphate and 2 cwt. of sulphate of potash, applied at the rate of 18 cwt. per acre.

The results of these 23 experiments are summarised in Table 1. In Tables A, B, and C of Appendix 1, the effect of varying the rate of application of each ingredient is given in detail.

TABLE 1.

SUMMARY OF RESULTS OF FERTILISER EXPERIMENTS WITH POTATOES IN WESTERN AUSTRALIA, 1922–1942.

The average response to each fertiliser treatment is shown by accepting as "standard" rates 4 cwts. of sulphate of ammonia per acre, 12 cwts. of superphosphate per acre, and 2 cwts. of sulphate of potash per acre. Each "standard" rate is valued at 100 per cent. in each experiment and the percentage yield of the other treatments calculated from the yield data.

Sulphate of Ammonia.		Superphosphate.		Sulphate of Potash.	
Rate of Application.	Yield.	Rate of Application.	Yield.	Rate of Application.	Yield.
lbs. per acre.	As per cent. of the "standard."	lbs. per acre.	As per cent. of the "standard."	lbs. per acre.	As per cent. of the "standard."
none	75	none	50	none	95
200–250	99	448–475	89	105–140	100
350	98	896–950	97	...	...
448–500	100	1,344–1,430	100	210–280	100
672	101	1,668–1,907	102	415–448	101

THE OPTIMAL DRESSING OF FERTILISERS FOR POTATOES IN WESTERN AUSTRALIA.

The experimental data reported above indicate that the optimal dressing of fertilisers for potatoes under average conditions in Western Australia are of the order of magnitude of—

Sulphate of ammonia (20.5% N.) 2 cwts. per acre.

Superphosphate (22.0% P_2O_5) 8 cwts. per acre.

Sulphate of potash (48.6% K_2O) 1 cwt. per acre.

There is no doubt that the standard fertiliser dressing adopted as a control in the experiments discussed above, namely, 4 cwts. of sulphate of ammonia, 12 cwts. of superphosphate, and 2 cwts. of sulphate of potash per acre, is in the luxury class.

The experiments have been conducted on a variety of soil types at various localities in the main potato-growing districts and include both winter and summer crops. There is, however, no clear-cut evidence of special district requirements or of special seasonal needs.

The dressing of superphosphate found necessary for optimal yields is about six times the amount actually absorbed by the tops and roots and tubers of a ten-ton crop and about seven times that contained in the tubers.

The "optimal" fertiliser requirements of nitrogen and potash are considerably less than absorption. This is due to the supplying power of the soil with respect to these substances. The microbial activities in the soil release nitrates in con-

siderable quantities in cultivated land and the maintenance of the nitrogen reserves by green manure and pasture crops is general practice. Under winter conditions, nitrogen deficiency may be more evident and nitrogenous fertilisers may be of considerable benefit during these months in many instances. The complete elimination of potash from the fertiliser mixture has only reduced the yields by five per cent. compared with 1 and 2 cwt. dressings (see Appendix 1, Table C). However, on account of the relatively large amounts of potash removed by the potato crop (see below) it may be considered sound practice to maintain the potash content of the soil even though no immediate profit would be obtained. When potash supplies are readily available larger amounts designed to approximate a replacement programme may be considered sound practice but no immediate profit would be obtained.

THE NET N, P, K REQUIREMENTS OF A POTATO CROP.

Before discussing the results of the experiments it is of interest to consider the amounts of soil ingredients removed by the crop, particularly the amounts involved in the saleable portion.

Table 2.

COMPOSITION OF POTATOES.

Analyses of Potatoes as published in the literature in comparison with data from Western Australian sources :—

Source of Information.	Water.	Ash.	Potash. (K_2O)	Lime. (CaO)	Magnesia. (MgO)	Phosphoric Acid. (P_2O_5)	Nitrogen. (N)
Results as Percentages of the Fresh Tubers—							
1. Warington (p. 74) (after Wolff)	75·0	·95	·57	·025	·047	·16	·34
2. Thorpe	75·0	·94	·56	·02	·04	·18	...
3. Sherman	...	...	·52	·02	·047	·133	...
4. Henry (1923)	78·8	1·1	...	...	...	...	·35
5. Winton	81·3	·9	...	...	...	...	·34
Western Australian Potatoes (11 samples)	81·5	·88*	·52*	·017*	·037*	·122*	·33
Results as Percentage of the Fresh Tops—							
Thorpe	77·0	1·18	·07	·55	·27	·06	·55†

* Calculated from data expressed on oven dry basis. † Boussingault reported by Storer (Agriculture, Vol. III., 1903, p. 120).

1. Warington, R.—Chemistry of the Farm (1909).
2. Thorpe.—Dictionary of Applied Chemistry, 4th Edition.
3. Sherman.—Chemistry of Food and Nutrition.
4. Henry.—Feeds and Feeding (1923).
5. Winton.—Structure and Composition of Foods, Vol. II.

There is only a limited amount of data in the general literature regarding the composition of potato tubers and very little concerning the other portions of the crop. The available information is summarised and compared with analyses of Western Australian potatoes in Table 2.

The figures indicate that Western Australian potatoes are generally much higher in water and lower in phosphoric acid than the others. With respect to ash, potash, lime, and magnesia, the local potatoes are but slightly inferior.

From the analyses of the Western Australian potatoes it has been calculated that the absorption per ton of fresh tubers amounts to 11.6 lbs. of potash (K_2O), 2.73 lbs. of phosphoric acid (P_2O_5), and 7.4 lbs. of nitrogen (N). In terms of fertilisers these amounts are equivalent to 36.1 lbs. of sulphate of ammonia (20.5% N), 12.4 lbs. of superphosphate (22% P_2O_5), and 23.9 lbs. of sulphate of potash (48.6% K_2O). For a 10-ton crop the figures would be—

Sulphate of ammonia—61 lbs. per acre.

Superphosphate—124 lbs. per acre.

Sulphate of potash—239 lbs. per acre.

With respect to the non-saleable portions of the potato plant, the work carried out by Boussingault in the last century and reported by Storer (Agriculture, Vol. III, 1903, page 120) indicates that the ratio of roots, tops, and other refuse to useable parts of potatoes, i.e., the tubers, is 1 : 3.35 on the dry basis.

Assuming this ratio to be correct and that the unsaleable portion of the potatoes approximates the composition of the tops, a rough approximation of the soil minerals absorbed by the total plant can be arrived at from the figures supplied by Thorpe and presented in Table 2. Accepting these assumptions, this fraction would contain for each ton of tubers produced, 3.9 lbs. of nitrogen (N), 0.42 lbs. of phosphoric acid (P_2O_5), and 0.50 lbs. of potash (K_2O). For a 10-ton crop of potatoes the absorption would thus be equivalent to an additional 190 lbs. of sulphate of ammonia, 19 lbs. of superphosphate, and 10 lbs. of sulphate of potash.

In round figures the total absorption for a 10-ton crop of potatoes would be—

Sulphate of ammonia—550 lbs. per acre.

Superphosphate—140 lbs. per acre.

Sulphate of potash—250 lbs. per acre.

DISCUSSION.

While of some interest, the amount of soil constituents absorbed by a crop are of but little importance as a basis for deciding optimal dressings. The results of field experiments are of far greater value and the other information serves chiefly to give some perspective of these data.

When a fertiliser is applied to the soil many things happen. Certain fertilisers, such as phosphate, ammonia, and potash, are partly absorbed by the clay and organic matter of the soil, while the microbial plants of the soil may be greatly stimulated and absorb another fraction of the application. Some may be washed

out of the root zone. The crop for which the fertiliser was intended has access to the remainder. Another complication arises from the fact that the soil is not inert and lifeless, but is constantly releasing constituents required for crop growth. With the exception of nitrogen, phosphate, and potash, Western Australian soils generally supply the mineral requirements of our crops. Only under special conditions do we use iron, magnesia, boron, copper, manganese, zinc, etc., as fertilisers, but, for potato and vegetable crops in particular, our soils do not supply nitrogen, phosphate, and potash, in adequate quantities for optimum crops and fertiliser mixtures containing these elements, are profitable.

Sulphate of ammonia and sulphate of potash are probably rarely applied in excess of the amount actually absorbed by the potato crop and, in experimental work, maximum yields are usually obtained with less on account of the supplying power of the soil. Phosphate is in a different category, however, as our virgin soils not only have a very low supplying power as far as sown crops are concerned, but they appear to be able to fix a large fraction of the added soluble phosphatic fertiliser in such a way that the crop cannot absorb it fast enough to meet maximum growth requirements. In consequence, we have to apply large amounts of phosphatic fertilisers and, for economy, apply these fertilisers in the row near the plants.

Western Australian soils are not singular in this requirement for phosphate, as reports from most parts of the world give instances of substantial crop responses to applications of phosphatic fertilisers far in excess of the amount actually taken up by the crop.

It would be unreasonable to expect any equitable rationing scheme in times of scarcity of fertiliser ingredients to allow more than optimal amounts even for the crops highest on the priority list and growers of most crops would have to be content with less. The fertiliser applications giving maximum crop returns from the national viewpoint would fall short of the maximum financial returns for the grower when fertiliser supplies are below optimal requirements. It is well established that the return from each additional unit of fertiliser applied decreases until the optimal amount is reached. Beyond this, the monetary return does not pay for the extra cost involved. This means that the greatest return per unit of fertiliser—say per cwt. of superphosphate—is for the first.

This principle is embodied in the well-known law of diminishing returns. Crowther and Yates, 1941, illustrate this law in the experience with superphosphate (16.7 per cent. P_2O_5) for potatoes in Great Britain. The yield increase in tons of potatoes per acre per cwt. of superphosphate used was as follows:—

Superphosphate Used.	1 cwt.	2 cwts.	3 cwts.	4 cwts.	5 cwts.	5·6 cwts. (optimal dressing)
Yield increases above no phosphate (tons per acre)	·23	·40	·51	·59	·65	·68
Yield increase per additional cwt. of superphosphate (tons per acre)	·23	·17	·11	·08	·06	·05*

* Calculated to 1 cwt. increase for comparison.

TABLE A.

POTATO FERTILISER EXPERIMENTS—WESTERN AUSTRALIA.

Effect of Various Dressings of Sulphate of Ammonia on the Yield of Potatoes.

Locality.	Growing Period.	Sulphate of Ammonia (lbs. per acre).										Other Fertiliser (lbs. per acre).	
		0.		200–224–250.		350.		448–500.		672.		Super-phosphate.	Sul-phate of Potash.
		Potato Yields per Acre.											
		tons.	%	tons.	%	tons.	%	tons.	%	tons.	%	lbs.	lbs.
Pinjarra (D. J. & F Paterson)	1922, summer	3·00 (100 lbs.)	....	3·01	....	....	....	....	....	....	....	200 (P_2O_5)	....
Burekup (C. L. Clarke)	1922, summer	5·68 (100 lbs.)	....	5·85	....	....	....	....	....	....	....	200 (P_2O_5)	....
	1925, July 3–November 17	....	....	5·22	89	5·98	102	5·87	100	....	....	1,430	204
	1926, July 19 November 30	....	....	5·19	96	5·52	103	5·38	100			1,430	204
	*1927, July–November	....	....	9·87	100	9·02	91	9·87	100			1,430	210
	*1928, July 11 November 27	....	....	6·73	99	6·36	93	6·83	100			1,430	210
	*1929 July 17–November 25	6·65	92	7·23	101			7·19	100			1,430	210
	1930, July November	4·8	73					6·6	100			1,200	..
Burekup (C. Badham)	*1935 July 24 November 27	..	..	11·8	90			13·0	100	13·75	105	1,344	224
Burekup	*1937, June 9 November	†	†	†	†	†	†	†	†	†	†	†	†
Benger (C. L Clarke)	1925, summer	..	....	3·80	103	3·60	98	3·69	100			1,430	204
	*1929, summer	..	..	6·38	96	6·25	94	6·65	100			1,430	210
Waroona (J. Salerian)	*1933, December 1934, April (new land)	6·85	72	12·7	134			9·5	100	10·7	113	1,344	224
	1934, November–1935, April	9·7	88	10·6 (168 lbs.)	96	....	....	11·1	100	10·4	94	1,344	224
	1941–42, summer	4·0	87	5·2	113	4·6	100	....	....	....	....	Factorial Design	Factorial Design
Gosnells (Seaforth)	*1929, July 4–November 4	2·99	45	5·18	78			6 61	100			1,430	210
	1934, June–November	3·75	63	5·5	92	....	....	5·95	100	5·95	100	1,344	224
Kelmscott	1930	3·08	59					5·22	100			1,120	
Herdsman's Lake	*1932, October 1933, January	..	..	9·75	99			9·85	100	9·4	95	1,344	224
Young's Siding—													
(T. H. Tonkin)	1925, November 11–1926, March 11	....	.	9·02	105	8·84	103	8·61	100	....	....	1,430	204
(E. W. Ovenall)	*1928, January May	..	..	4·82	102	4·73	100	4·73	100			1,430	210
Grasmere (B. H Burvill)	1939–40, summer (old potato land)	8·5	85	9·4	94			10·0	100			Factorial Design	Factorial Design
Many Peaks (B. H Burvill)	1939–40, summer (virgin swamp)	9·5	86	11·4	103			11 1	100			do.	do.
Mean		....	75	....	99	....	98	7·8	100	....	101	.	.
Range		....	45–92	....	78–134	....	91–103	....	....	....	94–113	. .	.
Number of Trials		....	10	....	18	....	9	19	19	....	5	.	....

* Data published in *Journal of Department of Agriculture, W.A.* † All treatments except one had 4 cwts. of sulphate of ammonia applied in various ways.

TABLE B.—POTATO FERTILISER EXPERIMENTS—WESTERN AUSTRALIA. *Effect of Various Dressings of Superphosphate on the Yields of Potatoes.*

Locality.	Growing Period.	Superphosphate† (lbs. per acre).										Other Fertiliser (lbs. per acre).	
		0.		448–475.		896–950.		1,344–1,430.		1,668–1,907.		Sulphate of Ammonia.	Sulphate of Potash.
		Potato Yields per acre.											
		tons.	%	tons.	%	tons.	%	tons.	%	tons. §	%	lbs.	lbs.
Pinjarra (D. J. and F. Paterson)	1922, summer	....	....	3·8	132	....	....	2·89	100	....	....	....	....
Burekup (C. L. Clarke)	1922, summer	....	....	4·48	84	....	....	5·35	100	....	....	....	....
	1925 July 13–November 17	....	....	4·82	85	5·67	100	....	....	....	....	500	204
	1926, July 19–November 30	....	....	5·91	86	6·23	91	6·84	100	....	....	500	204
	*1927, July–November	....	....	....	....	....	....	9·87	100	9·51 10·58	102	500	210
	*1928, July 11–November 27	....	....	....	....	....	....	6·98	100	6·34 6·66	93	500	210
	*1929, July 17–November 25	....	....	....	....	....	....	7·28	100	7·77 7·44	104	500	210
	1930, July–November	4·96	83	5·44	91	5·32	89	5·98	100	6·1	102	448	224
Burekup (C. Badham)	*1935 July 24–November 27	6·9	53	11·5	88	12·55	96	13·0	100	13·45	103	448	224
Benger (C. L. Clarke)	1925, summer	....	....	3·64	99	3·88	105	3·68	100	....	....	....	....
	1929, summer	....	....	....	....	....	....	7·05	100	6·92 7·05	99	500	210
Waroona (J. Salerian) .	*1933, December–1934, April (new land)	0·6	5	7·0	60	13·8	118	11·7	100	13·9	119	448	224
	1934, November–1935, April	....	....	10·4	94	9·4	85	11·1	100	9·2	83	448	224
	1941–42, summer	2·9	52	4·3	77	5·0	89	....	....	6·2	111	Factorial Design, 0–168–336	Factorial Design, 0–112–224
Gosnells (Seaforth)	*1929, July 4–November 4	....	....	....	....	....	....	5·8	100	6·47 6·12	108	500	210
	1934, June–November	5·2	87	5·05 (6 cwts.)	85	5·95	100	5·95	100	6·5	109	448	224
Kelmscott	1930	4·02	87	5·27	114	4·77	103	4·62	100	....	....	448	224
Herdsman's Lake	*1932, October 1933, January	4·7	45	8·4	80	....	....	10·5	100	....	....	448	224
Young's Siding— (T. H. Tonkin)	1925, November 11–1926, March 11	....	....	6·7	69	8·7	89	9·78	100	....	....	500	204
(E. W. Ovenall)	*1928, January–May	....	....	....	....	....	....	4·73	100	4·6 5·22	104	500	210
Grasmere (B. H. Burvill)	1939–40, summer (old potato land)	‡7·4	75	9·3	94	9·3	94	9·9	100	9·0	91	Factorial Design, 0–112–224–448	Factorial Design, 0–112–224 448
Many Peaks (B. H. Burvill)	1939 40 summer (virgin swamp)	‡1·6	14	9·7	87	10·8	104	11·2	100	11·1	99	Factorial Design, 0–112–224–448	Factorial Design, 0–112–224–448
Mean	....	....	50	....	89	....	97	7·6	100	....	102	...	...
Range	....	....	0–87	....	60–132	....	85–118	....	....	....	83–119	...	...
Number of Trials	....	....	10	....	16	....	13	....	20	....	14	....	....

* Results marked are published in *Journal, Department of Agriculture, W.A.*

† Superphosphate contained 18 per cent. P_2O_5 in 1922 experiments; 22 per cent. P_2O_5 in the experiments 1925 to 1935; 23 per cent. P_2O_5 in the experiments of 1936 and later.

‡ No fertiliser of any kind.

§ Where two figures are shown the upper one is for 1,668 lbs. and the lower one for 1,907 lbs.

TABLE C.

POTATO FERTILISER EXPERIMENTS—WESTERN AUSTRALIA.

Effect of Various Dressings of Sulphate of Potash on the Yield of Potatoes.

Locality.	Growing Period.	Sulphate of Potash (lbs. per acre.)								Other Fertiliser (lbs. per acre).	
		0.		105, 112–140.		210, 224, 280.		415–448.		Sulphate of Ammonia.	Superphosphate.
		Potato Yields per Acre.									
		tons.	%	tons.	%	tons.	%	tons.	%	lbs.	lbs.
Pinjarra (D. J. & F. Paterson)	1922, summer	3·33	82	3·55	87	4·08	100	....	....	45 (N)	215 (P_2O_5)
Burekup (C. L. Clarke)	1922, summer	5·78	95	6·0	98	6·1	100	....	....	45 (N)	215 (P_2O_5)
	1925, July 3–November 17	5·67	95	....	....	5·98	100	....	....	350	1,430
	1926, July 19–November 30	6·3	113	6·59	118	5·59	100	....	....	500	1,430
	*1927, July–November	9·37	95	....	....	9·87	100	9·87	100	500	1,430
	*1928, July 11–November 27	6·5	94	....	....	6·92	100	7·28	105	500	1,430
	*1929, July 17–November 25	6·74	103	....	....	6·52	100	6·83	105	500	1,430
	1930, July–November	4·78	93	....	....	5·13	100	....	....	....	1,344
Burekup (C. Badham) ...	*1935, July 24–November 27 ..	....	....	12·05	83	14·55	100	12·85	88	448	1,344
Burekup	*1937, June 9–November	6·5	89	....	....	7·3	100	....	....	448	1,344
Benger (C. L. Clarke)	1925, summer	3·64	101	....	....	3·6	100	....	....	350	1,430 or eqt.
	*1929, summer	6·25	90	....	....	6·92	100	6·87	99	500	1,430
Waroona (J. Salerian) ...	*1933, December 1934, April (new land)	9·6	84	12·7	110	11·4	100	12·25	107	448	1,344
	1934, November 1935, April	10·9	98	12·1	109	11·1	100	10·8	97	448	1,344
	1941–42, summer	4·3	98			4·5	100	4·9	109	Factorial Design, 0, 1½, and 3 cwts.	Factorial Design, 0, 4, 8, and 16 cwts.
Gosnells (Seaforth)	*1929, July 4–November 4	6·16	100	....		6·16	100	6·07	98	500	1,430
	1934, June–November	5·5	92	5·8	98	5·95	100	6·05	102	448	1,344
Kelmscott	1930	3·08	106	....	....	2·9	100	....	....	....	1,120
Herdsman's Lake	*1932, October–1933, January	10·6	101	....	....	10·5	100	....	....	448	1,344
Young's Siding—											
(T. H. Tonkin)	1925, November 11–1926, March 11	8·44	86			9·82	100	10·09	103	500	1,430
(E. W. Ovenall) ..	*1928, January–May	4·02	85			4·73	100	4·6	97	500	1,430
Grasmere (B. H. Burvill)	1939–40, summer (old potato land)	8·7	88	9·2	93	9·9	100	9·6	97	Factorial Design, 0, 1, 2, and 4 cwts.	Factorial Design, 4, 8, 12, and 16 cwts.
Many Peaks (B. H. Burvill) ..	1939–40, summer (virgin swamp)	10·3	95	10·8	100	10·8	100	10·9	101	do.	do.
Mean	....	....	95	....	100	7·4	100	....	101		
Range	....	.	82–113		83 118				88-109		
Number of Trials	....	22	....	9	....	23	....	14			

* Data published in *Journal of Agriculture, W.A.*

APPENDIX.

Appendix 1.

Tabulation of details of responses of potatoes to variations in fertiliser treatments—Tables A. B. and C.

Appendix 2.

"Fertiliser Policy in War-Time," "The Fertiliser Requirements of Arable Crops" by E. M. Crowther and F. Yates, *Empire Jour. Exp. Agric.* 9: 77-79, 1941.

(Review of a paper giving a summary of conditions in Great Britain and making important recommendations.)

This valuable paper from the Rothamstead Experiment Station, Harpenden, England, gives a summary of the results of several hundred single year fertiliser experiments conducted since 1940 in Great Britain on the main arable crops, cereals, root crops, and potatoes. Some results from Ireland, Sweden, Denmark, and East Prussia are given for comparison. From these data the basis of a flexible fertiliser policy directed toward maximum production for the most necessary crops in Great Britain under wartime conditions is laid down.

The position is that in Great Britain potash and phosphate are in short supply but there is adequate sulphate of ammonia. In general, farmers are not using adequate nitrogen fertilisers, especially on cereals, and production can be improved simply by taking advantage of the response of arable crops to nitrogen. This will result in more profit to the farmer and more food for the nation. Phosphate and potash can be economised greatly by the use of dung so that available supplies may be reserved for the most responsive crops.

The results of this inquiry are of general interest—particularly to Australian farmers who face similar problems but are less fortunate in that they have access to a fraction only of their nitrogen requirements.

Optimal Dressings of Fertilisers.

From the data available Crowther and Yates calculate the optimal dressings of each fertiliser ingredient for each arable crop, i.e., the dressing which will result in maximum net financial return to the farmer under average conditions. On account of the importance of the conception of the optimal dressing, an example is given for sulphate of ammonia on potatoes grown with dung. In this example potatoes are valued at £5 10s. sterling per ton, and sulphate of ammonia at 12s. 6d. per cwt. No allowance is made for the extra handling and selling costs involved with the higher yield (Table 6 of Crowther and Yates, P. 89).

TABLE 6.

CASH RETURN FROM THE USE OF SULPHATE OF AMMONIA FOR POTATOES (PER ACRE).

Dressings with Sulphate of Ammonia.		Responses.†		Net Return.
cwts.	cost.	tons.	value.	
1·2*	15s.	·9	99s.	84s.
2	25s.	1·26	139s.	114s.
3	38s.	1·53	168s.	130s.
4	50s.	1·69	186s.	136s. (optimal)
5	62s.	1·78	196s.	134s.
6	75s.	1·84	202s.	127s.
7	88s.	1·87	206s.	118s.

* About average English dressing. † The response is the *increase* in yield or monetary return which results from the use of any particular amount of fertiliser—in this case, sulphate of ammonia.

For potatoes in the West Midlands and North England counties, probably the most extensive potato growing areas, the optimal dressing of fertiliser for potatoes on the average would be (taken from Crowther and Yates' figures):

	With Dung.	Without Dung.
	cwt.	cwt.
Sulphate of ammonia	4·1	4·3
Equivalent to nitrogen (N)	·86	·9
Superphosphate	5·6	7·9
Equivalent to phosphoric acid (P_2O_5)	·93	1·3
Potassic fertiliser	2·0	2·7
Equivalent to potash (K_2O)	1·0	1·4

The average amounts of fertiliser in a random sample of 500 farms in 1937 were 0.36 cwt. of nitrogen (N), 0.63 cwt. of phosphoric acid (P_2O_5), and 0.68 cwt. of potash (K_2O) per acre. Obviously, farmers in England generally under-fertilise their potato crops, particularly with respect to nitrogen.

Fertiliser Policy.

From the Law of Diminishing Returns, the authors deduce that "the maximum financial returns from a fertiliser on an average farm or throughout the country will be greatest when each group receives its optimal dressing. With smaller supplies of a fertiliser the greatest returns will be obtained when the total amount on a farm or throughout the country is distributed so that the dressings for all crops are reduced by the same amount below their optimal dressings."

Adequate supplies of fertilisers for optimal dressings are most economical and highly desirable, but where reduced supplies are available restrictions in applications should be made according to a scale based on the Law of Diminishing Returns. With diminishing supplies of superphosphate on a farm growing root crops and potatoes with dung, and cereals without dung, the allocation of superphosphate (16.7% P_2O_5) in cwt. per acre may be as follows (example from Crowther and Yates):—

Allocation.	Potatoes.	Swedes.	Sugar Beet.	Mangolds.	Cereals.
1 (optimal)	7·3	6·5	4·9	3·8	3·1
2	5·8	5·0	3·4	2·3	1·6
3	4·3	3·5	1·9	0·8	0·1
4	2·8	2·0	0·4	none	none
5	1·3	0·5	none	none	none

Estimated Benefits from Increased Fertiliser Applications in Great Britain.

Crowther and Yates estimate that on the basis of pre-war acreages, the raising of the fertiliser ingredients from the usage of the past to the optimal dressings would result in the following net increases in the value of the arable crops under discussion:—

	£
Nitrogenous fertiliser	19,400,000
Phosphatic fertiliser	5,000,000
Potassic fertiliser	3,100,000

These figures are all based on hypothetical average conditions. It is not claimed that each soil type on each farm will behave the same and the need for appropriate adjustments according to known fertiliser requirements of various soil types is recognised. The point is also made that crops should be grown on those soils most suitable under the fertiliser allocation. It is also suggested that analytical methods should be used where possible to assist in arriving at sound decisions.

Farm Manure.

M. CULLITY, SUPERINTENDENT OF DAIRYING.

In previous notes (*Journal of Agriculture*, June 1942) the value of farm manure was stressed. A plea was made that farmers, and particularly dairy farmers, should utilise all available means of returning to the soil the materials voided by the stock, because this manure contains great fertilising value. In fact, the means of accurately assessing its value are not available. It was shown that in addition to supplying valuable plant food, the organic matter had a great improving effect on the physical condition of the soil, and that plant food present in the soil and in the air in an unavailable form can, by chemical changes with the constituents of the manure, and by the action of bacteria which are present in great numbers, be converted to forms which can be used.

There are two main points where attention can be given to the conservation and utilisation of the dung. It has been estimated that approximately 75% falls in the paddocks where stock are grazing, and 25% in the laneways, yards and bails.

1. *Treatment of Dung Falling in Paddocks.*

Pasture harrows which will distribute stock droppings should be part of the equipment of every farm. Without this equipment the dung will be left undis-

A large proportion of a pasture will become unpalatable and so useless if Dung is not spread.

turbed to promote tufts of rank grass which will be avoided by the stock. The effect of not distributing the dung can be seen on most farms, and there is no doubt that a serious reduction in grazing area results. Occasionally paddocks are seen where up to 40% of the total area is taken up by these areas of rank unpalatable growth, and the owners apparently do not realise that nearly half the carrying capacity is being sacrificed.

To get the maximum result from harrowing, this work should be carried out immediately after the stock are removed from the paddock. In this way the droppings will be spread before the evaporation of moisture causes them to harden and cake. Subsequent falls of rain will then wash the greater part into the soil.

The failure to spread the manure quickly in this way also allows the escape of a considerable amount of the nitrogen into the air.

No fouling of the pasture will result when paddocks are harrowed regularly after grazing and grazing is controlled on a rotational basis.

The regular and even spreading of the droppings will assist in building up the fertility of the topsoil, where the roots of the pasture feed, and so maintain them in consistent and rapid growth. The higher the fertility can be raised in this way, the easier it will be found to introduce the higher producing pasture plants such as perennial ryegrass.

The implements which may be used for this purpose vary from the ordinary diamond harrow, which does only a very indifferent job, to the chain harrow, which is designed primarily for this work. The cutting type of pasture harrow also does very good work, and sometimes is used with effect when the droppings have been allowed to harden. In similar circumstances, the chain harrow would prove useless unless the droppings had been softened again by rain.

2. *Manure from Stables, Cowbails and Yards.*

As indicated earlier it has been calculated that only about 25% of the dung voided falls near stables and yards. The work of returning this to the paddocks will normally entail a regular call on available labour. It is this repeated call on farm labour which is responsible for the failure to utilise the manure to the best advantage. It is suggested, therefore, that its systematic utilisation will only be maintained if and when suitable conveniences are provided for collecting the solid dung and urine and for returning it to the paddock.

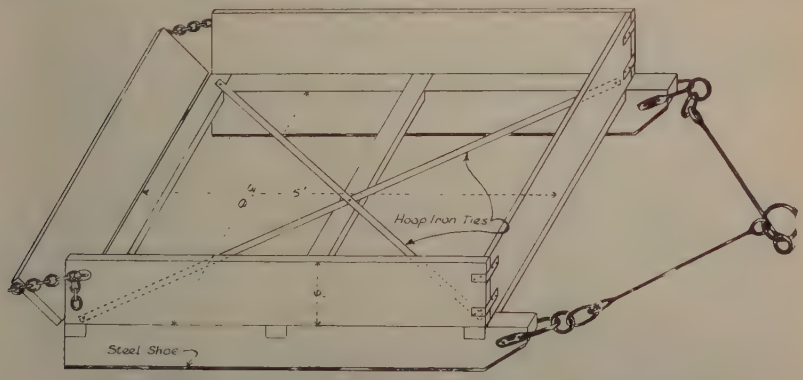


Diagram of manure sledge with loose bottom removed to show construction. The loose bottom is made of boards 1in. thick, cleated together.

The first essential for allowing the easy collection of manure is good floors in all buildings where stock are stabled or milked. Concrete yards at cow bails also assist in rendering the collection of the dung easy. Many farmers find that the daily transport of the manure to the paddock is most easily achieved by having a small horse-drawn sledge near the sheds. The smallest amount of labour is then required for loading and unloading. A diagram of such a sledge is shown in figure 1.

The cultivation of the land as soon as possible after spreading will assist in reducing the loss which will occur through volatilisation of some of the nitrogenous substances.

However, this cannot be managed easily where the dung is spread daily, but it should be possible to use a light cultivator or pasture harrow at regular intervals in order to break the material into small pieces and to partly cover them.

A frequent practice is to heap the manure in a corner of the yards until it is required for a crop or until the heap reaches such proportions that there is no option but to cart it away. When this method is followed, a very considerable loss occurs in drainage and in volatilisation.

If it is desired to store the manure for a special purpose, such as for use in manuring a crop of maize or potatoes, the best method is to use a pit, which has an impervious bottom and sides. Admittedly there are few, if any, pits installed on farms in this State, but if farmers are really concerned with the future fertility of their farms, their attention to the advantages of manure pits, particularly during these times of fertiliser shortages, is advisable. The only loss which will occur from manure stored in this way will be in the escape of gases to the air.

In other countries great attention is given to this matter and also endeavours are made to conserve not only the solid but also the liquid excrement. Tanks have been designed fitted on low sledges, and having distributor outlets. These tanks are filled at the drainage outlets from sheds, particularly milking bails, and are taken direct to the paddocks where the urine diluted with water, is spread over the ground.

It is realised that it will not be possible for all farmers to conserve and utilise all the manure available on their properties, but wherever possible, and as far as possible, farm manure should be returned to the soil to maintain or even increase fertility, to allow better crops to be grown, and allow the establishment of pastures of higher carrying capacity.

The Official Australian Pure Bred Dairy Cattle Production Recording Scheme.

REPORT FOR YEAR ENDING 30th JUNE, 1942.

M. CULLITY, Superintendent of Dairying; B. H. DRAKES, Recording Officer.

The testing year just concluded has been one of difficulties for farmers and for those responsible for organising work. Periodic upsets were experienced partly due to the unsettling effects of the progress of the war, such as was experienced when hostilities were opened by Japan. The enlistment of sons of farmers and of farm hands made the actual work on the farms more exacting on those who remained behind.

In these circumstances, therefore, it is pleasing to be able to report that the decline in the number of herds and of the cows tested was not nearly so large as was anticipated.

The number of herds and cows tested was only two and eighty-two, respectively, less than in 1940-41, and present indications do not suggest that there will be a further decline in numbers during the present season.

TABLE 1.

AVERAGE PRODUCTION OF PURE-BRED COWS UNDER OFFICIAL TEST.

Year.	Number of Cows Completing Test.	Average Butterfat per Cow.
		lbs.
1934–35	305	320·26
1935–36	367	297·17
1936–37	319	309·87
1937–38	333	298·08
1938–39	375	292·40
1939–40	382	305·88
1940–41	372	298·38
1941–42	290	322·84

Despite the excellent grazing which was available, it was expected that the unsettled conditions would militate against high yields.

The record average production of 322.84 lbs. butterfat is, therefore, a very meritorious result for the breeders. This figure was 24.46 more than that obtained in 1941-42 and 16.96 lbs. higher than the previous highest average established in 1939-40.

A number of new individual records were made.

Senior Three-year-old.

"Glanavon Tiny 5th," an A.I.S. cow owned by Messrs. Bevan & Sons, produced 14,322 lbs. milk, 4.27 per cent. test, 612.11 lbs. butterfat, establishing record for—(1) all breeds senior three-year-old; (2) A.I.S. three-year-old; (3) W.A. bred three-year-old.

"Koojan Bo-Peep 2nd," a Guernsey cow owned by Mr. A. W. Padbury produced 9,639 lbs. milk, 5.69 per cent. test, 548.93 lbs. butterfat, which is a record for Guernsey three-year-old cow.

Junior Three-year-old.

"Glanavon Dahlia 7th," an A.I.S. cow owned by Messrs. Bevan & Sons produced 13,035 lbs. milk, 4.41 per cent. test, 575.57 lbs. butterfat, establishing a new record for (1) A.I.S. three-year-old; (2) W.A. bred three-year-old; (3) all breeds junior three-year-old.

Senior Two-year-old.

"Koojan Ideal's Jewel," owned by Mr. A. W. Padbury, produced 12,397 lbs. milk, 5.30 per cent. test, 657.65 lbs. butterfat, establishing records for —(1) all breeds senior two-year-old; (2) W.A. bred two-year-old; (3) Guernsey two-year-old.

Junior Two-year-old.

"Glanavon Doris 7th," owned by Messrs. Bevan & Sons, established a new record for an A.I.S. Junior 2 by producing 11,796 lbs. milk, 3.83 per cent. test, 451.49 lbs. butterfat.

These records give further evidence of endeavours made by breeders to manage their herds so that maximum production may be obtained. Each year it is becoming more evident that it is most desirable and necessary for stud breeders to demonstrate the capacity of their herds for production. The high yields which have been obtained in grade herds render it difficult for their owners to select bulls for future herd sires which will have any likelihood of getting daughters which will be more productive than their dams.

To fulfil their function in the industry the breeders of pure bred stock are expected to breed the future herd sires which will be used in improving the quality of the commercial herds. It is accepted that it is more difficult to increase the production of a high producing herd, but this fact should only emphasise still further, the efforts which should be made to lift the production of the stud herds. From the information gained by recorders during their work, it appears that quite a number of herds could record higher productions if the feeding programme were on a higher plane.

The information given in table 2 provides an interesting resumé of testing over the past six years. It will be noted that the percentage of cows passing the standard set, has been, until last year, only a little better than 50 per cent. This means that for every cow which passed the standard, another cow did not reach that level of production.

TABLE 2.

PERCENTAGE OF COWS PASSING STANDARD.

Year.	A.I.S.	Guernsey.	Jersey.	Total.
1941–42	73·1	68·3	59·7	68·3
1940–41	52·0	61·0	51·0	54·0
1939–40	48·0	77·5	64·2	59·2
1938–39	53·8	71·4	55·2	57·9
1937–38	59·1	68·7	35·6	53·1

It is expected that as time goes on, the proportion of cows which do not reach the standard will be reduced.

TABLE 3.

COWS PASSING STANDARD.

Age Class.	A.I.S.		Guernsey.		Jersey.		All Breeds.	
	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.
Mature	39	28	19	11	15	7	73	46
Senior, 4 years	14	8	1	....	3	1	18	9
Junior, 4 years	9	8	4	2	6	4	19	14
Senior, 3 years	15	12	6	6	6	3	27	21
Junior, 3 years	13	10	11	10	7	5	31	25
Senior, 2 years	20	16	9	6	13	8	42	30
Junior, 2 years	46	32	13	8	21	13	80	53
Totals	156	114	63	43	71	41	290	198
Percentage Passing Standard	73·1		68·3		57·7		68·3	

Table 3 gives further information regarding the number of cows grouped according to breed and age reaching the standard during the year just concluded. It will be noticed that the greatest proportion of passes were registered in the Senior two-year-old, the Junior and Senior three-year-old and the Junior four-year-old classes.

The average production of the cows in each class according to breed are shown in Table 4. Owing to isolated high yields by individuals in the classes, the averages do not proceed evenly from the Junior two-year-old to the mature classes. For example it will be noticed that the Senior three-year-old and the Junior four-year-old A.I.S. class were approximately equal to the mature class, while in the Senior three-year-old class in the Guernsey, the production is nearly 400 lbs. On the other hand, some very poor results may be seen and the hope is expressed that breeders will use every endeavour to improve the figures during the current year.

TABLE 4.

AVERAGE BUTTER-FAT PRODUCTION IN EACH CLASS.

Age Class.	A.I.S.		Guernsey.		Jersey.		All Breeds.	
	No. of Cows.	Average Butter-fat.	No. of Cows.	Average Butter-fat.	No. of Cows.	Average Butter-fat.	No. of Cows.	Average Butter-fat.
		lb.		lb.		lb.		lb.
Mature	39	739·93	19	407·27	15	343·44	73	379·54
Senior, 4 years	14	334·13	1	290·55	3	347·83	18	334·00
Junior, 4 years	9	376·45	4	311·31	6	303·11	19	340·53
Senior, 3 years	15	378·60	6	397·95	6	261·98	27	356·98
Junior, 3 years	13	343·98	11	342·86	7	310·08	31	335·93
Senior, 2 years	20	300·11	9	318·25	13	279·84	42	297·72
Junior, 2 years	46	274·78	13	244·48	21	257·07	80	265·21

Of the herd sires whose daughters were under test, the following merit mention:—

"Blacklands Jean's Supreme" (1871). Sire: "Fussy's Monarch of Hillview"; Dam: "Jean 7th of Blacklands."

Ten daughters under test averaged 391.01 lbs. butterfat without allowances. The six highest producing daughters gave 470.22 lbs. without allowances, which is equivalent to 522.35 lbs. when adjusted.

"Parkview Commodore" (306). Sire: "Jean's Monarch of Blacklands; Dam: "Mayflower 9th of Parkview."

This bull had 17 daughters under test and their average production was 381.75 lbs. butterfat without allowances. The six best daughters averaged 467.66 lbs. without and 521.16 lbs. with allowances.

"Koojan Golden Prosper" (2283). Sire: "Koojan Golden Governor; Dam: "Koojan Bonnie Jean."

Only six daughters were under test for an average production of 476.71 lbs. butterfat without, and 489.23 lbs. with allowances.

"Parkview Guardian" (2557). Sire: "Parkview Guardsman"; Dam: "Parkview Eva 12th."

Twenty daughters averaged 366.17 lbs. without allowances. The best six, all mature cows, produced 452.79 lbs.

TABLE 5.

COWS WHICH COMPLETED TEST DURING THE TWELVE MONTHS ENDED 30TH JUNE, 1942.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk Last Day of Test.	Weight of Milk for Period.	Average Test.	Weight of Butter Fat for Period.	Owner.	Sire.
						lb.	lb.	%	lb		
COWS UNDER 2½ YEARS—STANDARD 230 LB. BUTTER FAT.											
Glanavon Doris 7th	A.I.S.	....	2-12-38	17-5-41	273	4·2	11,796	3·83	451·49	D. Bevan & Sons ...	Glanavon Franklin (4928)
Capel Model 5th	do.	....	27-4-39	12-7-41	273	28·5	11,021	3·90	429·89	B. W. Prowse	Capel Star King (4672)
Glanavon Dahlia 9th	do.	....	19-1-39	6-7-41	273	25·5	9,827	4·13	406·05	D. Bevan & Sons	Glanavon Golden Boy (4830)
Juadine March Flower	Jersey	....	5 3-39	6 9-41	273	21	7,728	5·01	387·83	Miss L. G. Hancock	Austral Park Wonderful Standard (12423)
Travalgan Lady Mint 8th	do.	79294	3 5-39	2-7 41	273	18	6,534	5·81	379·94	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Capel Model 7th	A.I.S.	....	8-7-39	13-7-41	273	29·5	9,749	3·88	378·20	B. W. Prowse	Capel Lottie's Reward (3782)
Glanavon Buttercup 3rd	do.	....	17-9-38	11-2 41	273	33	9,429	3·98	375·32	D. Bevan & Sons	Glanavon Golden Boy (4830)
Koojan Ideal's Bluebell	Guernsey	8807	15-1-39	22-2-41	273	18	6,234	5·98	372·14	A. W. Padbury	Glenburnie Ideal (imp. U.S.A.) (2548)
Capel Rose	A.I.S.	....	9 6-39	11-8-41	273	24	8,832	4·19	370·14	B. W. Prowse	Capel Lottie's Reward (3782)
Glanavon Tosca	do.	....	14-3-39	26-8-41	273	23	8,139	4·50	366·53	D. Bevan & Sons	Parkview Commodore (306)
Grass Vale Lady Fowler 27th	Jersey	76602	13-3-39	15-8-41	273	19	6,297	5·76	362·98	R. H. Rose	Grass Vale Gold Boy (14684)
Tipperary Beauty 7th	A.I.S.	.	27-7-39	2-10-41	273	32	8,016	4·48	359·80	W. G. Burges ...	Wooroloo Melba's Triumph (4491)
Glanavon Lulu 2nd	do.	....	10-2-39	24-7-41	273	28	9,024	3·95	356·65	D. Bevan & Sons	Parkview Commodore (306)
Glanavon Glenys	do.	...	14-10-39	7 8-41	273	29·5	8,751	3·96	346·79	D. Bevan & Sons	Tipperary President (5335)
Glanavon Golden Girl 3rd	do.	....	18-9-38	9 12-40	273	23	8,934	3·80	341·41	D. Bevan & Sons	Parkview Commodore (306)
Juadine Peerless Lily 15th	Jersey	..	20-5-39	21-9-41	273	19	6 522	4·94	322·61	Miss L. G. Hancock	Austral Park Wonderful Standard (12423)
Travalgan Lady Eion 6th	do.	79293	19-8 39	13-7 41	273	15	5,550	5·71	317·16	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Glanavon Doris 8th	A.I.S.	...	1-12-38	22 2-41	273	24	7,752	4·06	314·75	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Wooroloo Lilac	do.	28649	29-8-38	9-10 40	273	22	7,506	4·19	314·40	Wooroloo Sanatorium Farm	Glanavon Genius (3957)
Capel Dairymaid 2nd	do.	....	28-4-39	13-7-41	273	24	8,067	3·88	313·14	B. W. Prowse	Capel Lottie's Reward (3782)
Koojan Ideal's Dulcie	Guernsey	8810	25-10 38	23-1-41	273	17	5,451	5·73	312·38	A. W. Padbury ...	Glenburnie Ideal (imp. U.S.A.) (2548)
Tipperary Lovely 3rd	A.I.S.	...	1 5-39	14-7 41	273	24	7,302	4·26	310·87	W. G. Burges	Blacklands Monarch's Commander (1877)
Travalgan Starbright 7th	Jersey	79295	25-5 39	28 5-41	273	15	5,540	5·59	310·01	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Denmark Velveteen	Guernsey	....	24 7 39	25 8-41	273	13	5,716	5·32	304·22	Denmark Research Station	Koojan Ace's Goldseeker (3431)
Wooroloo Glory	A.I.S.	28643	19 6-38	5-12-40	273	23	7,089	4·22	299·18	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Capel Roan Queen	do.	....	19-7-39	6-7-41	273	16	7,368	4·03	297·28	B. W. Prowse	Capel Lottie's Reward (3782)
Koojan Golden Jasmine	Guernsey	8804	26-4-39	22-7-41	273	12·5	5,293	5·38	285·31	R. J. Giles	Coogely Myrtle's Prince (4769)
Glanavon Fussy	A.I.S.	...	21-4-39	3 8-41	273	23	7,794	3·63	283·41	D. Bevan & Sons	Tipperary President (5335)

Grantham Dreaming Fairy 2nd	Jersey	76596	20-4-39	2-10-41	273	15·5	4,996	5·66	283·06	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Muresk Delia	Guernsey	9105	11-5-39	25-6-41	273	15	6,225	4·50	281·59	Muresk Agricultural College	Denmark Damon (2519)
Yanget Gwen 5th	A.I.S.		26-3-39	9-8-41	273	17	7,206	3·88	280·23	E. T. Thatcher	Leylands Defiance (2380)
Grass Vale Buttercup 7th	Jersey		9-9-39	23-8-41	273	17·5	5,482	4·95	273·81	R. H. Rose	Grass Vale Gold Boy (14684)
Claremont Whitby Maid 35th	A.I.S.		29-3-39	11-6-41	273	19	6,267	4·29	268·84	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Claremont Rachel 12th	do.		19-8-38	30-11-40	273	22	6,479	4·05	262·58	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Claremont Maggie Morrison 32nd	do.		15-4-39	3-8-41	273	19	6,147	4·21	258·81	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Grass Vale Lady Fowler 29th	Jersey		9-9-39	24-8-41	273	15	4,590	5·60	257·43	R. H. Rose	Grass Vale Gold Boy (14684)
Glanavon Vida 3rd	A.I.S.		19-5-39	7-9-41	273	26	7,128	3·59	256·55	Burkitt & Brown	Parkview Commodore (306)
Brookfields Faith 2nd	Guernsey		2-10-39	25-8-41	273	12	4,431	5·66	251·04	P. G. Hampshire & Son	Yarraview Clarionet 2nd (4629)
Yanget Pretty Maid 4th	A.I.S.		7-10-39	11-8-41	273	14	5,682	4·40	250·02	W. G. Burges	Leylands Defiance (2380)
Greenmount Milkmaid 3rd	Jersey		16-8-39	30-4-41	273	9	4,580	5·45	249·72	A. G. Scott	Bellefaire Bonaparte's Bonetienne (9224)
Grass Vale Golden Cream 20th	do.		9-12-39	28-8-41	273	12	4,671	5·34	249·71	R. H. Rose	Grass Vale Gold Boy (14684)
Lenmoors Joan	A.I.S.		13-8-39	8-10-41	273	20	6,400	3·85	248·95	G. W. Marston	Longridge Blanche's Emblem (3344)
The Wold Fairy Crescendo	Jersey		27-4-39	30-6-41	210	5	4,410	5·61	247·77	L. C. Field	Grantham Fairy King (13765)
Claremont Blossom 28th	A.I.S.		16-2-39	20-6-41	273	19	6,357	3·82	243·07	Claremont Hospital for Insane	Claremont Max Hero (3802)
Claremont Cleggett 16th	do.		21-5-39	10-8-41	273	16	5,838	4·14	241·75	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Claremont Beanie 9th	do.		11-8-38	16-11-40	273	16	5,598	4·31	241·41	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Claremont Fancy 8th	do.		5-5-39	1-9-41	273	17	5,811	4·14	241·14	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Denmark Velvet	Guernsey	8540	23-8-38	22-11-40	273	18	4,554	5·27	240·27	Denmark Research Station	Denmark Auric (3313)
Grass Vale Lady Fowler 28th	Jersey		8-10-39	10-9-41	273	12	4,161	5·77	240·13	R. H. Rose	Grass Vale Gold Boy (14684)
Claremont Mabel 16th	A.I.S.		14-2-39	23-6-31	273	15	5,880	4·03	237·28	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Claremont Blossom 29th	do.		26-3-39	11-6-41	273	15	5,745	4·09	234·96	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Claremont Blossom 30th	do.		28-5-39	19-7-41	273	17	5,901	3·94	232·84	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Pleasant Hill Eleanor	Guernsey	9246	31-8-38	28-10-40	273	18·5	4,586	5·02	230·23	P. G. Hampshire & Son	Yarraview Magnet (3867)
Claremont Belle 23rd	A.I.S.		17-2-39	14-6-41	273	17	5,481	4·18	229·01	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Claremont Clara 13th	do.		10-3-39	2-6-41	273	15	5,025	4·51	226·75	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Claremont Maggie Morrison 34th	do.		13-5-39	13-7-41	273	15	5,685	3·95	224·59	Claremont Hospital for Insane	Claremont Ora's Triumph (4689)
Claremont Maggie Morrison 31st	do.		7-3-39	12-8-41	273	20	5,700	3·92	223·82	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Grass Vale Buttercup 5th	Jersey		22-6-39	16-8-41	240	8	3,870	5·70	220·70	R. H. Rose	Grass Vale Gold Boy (14684)
Claremont Plum 7th	A.I.S.		28-6-39	24-9-41	273	15	5,445	4·01	218·79	Claremont Hospital for Insane	Claremont Max Hero (3802)
Claremont Beauty 16th	do.		28-1-39	5-7-41	273	16	5,628	3·88	218·72	Claremont Hospital for Insane	Claremont Max Hero (3802)
Claremont Star 21st	do.		14-3-39	12-7-41	273	15	5,265	4·15	218·56	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Claremont Blanche 11th	do.		12-5-39	9-8-41	273	13	5,229	4·08	213·78	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk Last Day of Test.	Weight of Milk for Period.	Average Test.	Weight of Butter Fat for Period.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS UNDER 2½ YEARS—STANDARD 230 LBS. BUTTER-FAT—*continued.*											
Capel Model 6th	A.I.S		24-5-39	13-8-41	240	6·5	4,965	4·16	207·03	B. W. Prowse	Capel Lottie's Reward (3782)
The Wold Starbright Princess 2nd	Jersey		4-5-39	30-6-41	210	6	3,825	5·38	206·10	L. C. Field	Grantham Fairy King (13765)
Claremont Beauty 15th	A.I.S.		6-10-38	29-3-41	273	16	5,238	3·93	205·91	Claremont Hospital for Insane	Claremont Max Hero (3802)
Travalgan Lady Eion 5th	Jersey	79292	25 5-39	11-6-41	273	9	3,357	6·11	205·33	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Denmark Ace's Rosa	Guernsey	8523	24-4-39	21 12-40	273	16	3,588	5·70	204·62	Denmark Research Station	Koojan Ace's Goldseeker (3431)
Claremont Cocky 17th	A.I.S.		23-5 39	26-7-41	273	17	4,881	4·15	202·86	Claremont Hospital for Insane	Wooroloo Triumph 4th (3627)
Brookfields Queen 6th	Guernsey	8390	2 3 39	1-12 40	273	16·5	4,475	4·44	198·72	P. G. Hampshire & Son	Brookfields Baron (3936)
Denmark Damon's Pekoe	do.	8525	23-10 38	1-11-40	273	12	3,876	5·08	198·04	Denmark Research Station	Denmark Damon (2519)
Claremont Clarrie	A.I.S.		3-6-39	22-8-41	273	16	4,968	3·92	194·95	Claremont Hospital for Insane	Claremont Max Hero (3802)
The Wold Easter Daisy 2nd	Jersey		22-4-39	26-6-41	180	12·5	3,750	5·13	192·36	L. C. Field	Grantham Fairy King (13765)
Namder Princess	do.		24-9-39	13-7-41	273	6	2,988	6·24	186·54	H. S. Redman	Crantock Starbright's Napoleon (14551)
The Wold Fairy Lady 2nd	do.		15-4-39	24 7-41	180	7·5	3,480	5·01	174·36	L. C. Field	Grantham Fairy King (13765)
The Wold Fairy Mooltha 2nd	do.		1-6-39	10-7-41	150	17	2,940	5·77	169·74	L. C. Field	Grantham Fairy King (13765)
Rosella Queen	Guernsey	9315	3-7-39	14-7-41	150	16·5	3,210	5·12	164·22	W. Darnell	Muresk Paul (4356)
The Wold Air Daisy 3rd	Jersey		19-7-39	10 7-41	210	5	3,165	5·09	161·28	L. C. Field	Grantham Fairy King (13765)
Narrogin Aster	A.I.S.		1-6-39	8-5-41	240	8	3,750	4·27	160·05	Narrogin School of Agriculture	Wooroloo Stirling 3rd (3626)
Rosella Queenie	Guernsey	9316	20-9-39	19-7-41	150	15	2,775	4·88	135·48	W. Darnell	Muresk Paul (4356)
The Wold Daisy Northwood 2nd	Jersey		24 7 39	21-6 41	120	17	2,235	5·74	128·34	L. C. Field	Grantham Fairy King (13765)
Claremont Whitby Maiden	A.I.S.		18-5-39	30-7-41	150	14	3,210	3·79	121·74	Claremont Hospital for Insane	Wooroloo Jean 2nd's Guardian (4488)
Grass Vale Golden Cream 19th	Jersey		16 10-39	25-10-41	90	16	1,733	6·03	104·45	R. H. Rose	Grass Vale Gold Boy (14684)
Rosella Duchess 2nd	Guernsey		7-5-39	18-10-41	60	25·5	1,575	5·16	81·30	W. Darnell	Muresk Paul (4356)
Rosella Lady Gay	do.		6-6-39	20-4-41	60	13·5	795	5·05	40·17	W. Darnell	Muresk Paul (4356)
COWS 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LB. BUTTER-FAT.											
Koojan Ideal's Jewel	Guernsey		14 4-38	7-3-41	273	40·5	12,397	5·30	657·65	A. W. Padbury	Glenburnie Ideal (2548)
Juadine Peerless Lily 13th	Jersey	76977	20-12 38	14 9 41	273	21	7,830	5·72	447·92	Miss L. G. Hancock	Austral Park Wondertul Standard (12423)
Glanavon Cowslip 5th	A.I.S.		27 10-38	5-8-41	273	28	9,894	4·16	412·53	D Bevan & Sons	Parkview Commodore (306)
Muresk Diana	Guernsey	7634	8-7 38	13-6-41	273	19	7,437	5·21	387·56	Muresk Agricultural College	Koojan Ace's Goldseeker (3431)

Travalgan Lady Elon 4th	Jersey	74240	28-8-38	27-6-41	273	16	6,513	5·80	377·75	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Glanavon Rosina 2nd	A.I.S.	.	17 9-38	21-8-41	273	20	9,150	4·07	372·98	D. Bevan & Sons	Glanavon Golden Boy (4830)
Travalgan Starbright 6th	Jersey	..	31-5-38	30-4 41	273	19	6,462	5·62	363·27	W. H. & T. F. Robinson	Glen Iris Golden Oxford (12694)
Glanavon Rosette 4th	A.I.S.	....	11-3-39	18-9-41	273	23	9 324	3·76	351·29	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Sabina Vale Silvermine 11th	Jersey	78832	18-11 38	8 8-41	273	15	7,305	4·80	351·29	J. A. Sears	Belgonia Peggy 9th's Design (14424)
Wooroloo Peggy	A.I.S.	28653	29-8-38	7 8-41	273	25	8,745	3·98	348·43	Wooroloo Sanatorium Farm	Wooroloo Melba's Triumph (4491)
Koojan Golden Ripple	Guernsey	7248	26-3 38	14 12-40	273	18	5,994	5·74	344·28	Denmark Research Station	Homestead Ace (1631)
Glanavon Cowslip 4th	A.I.S.	....	17 2-38	4-11 40	273	23	7,239	4·75	343·55	D. Bevan & Sons	Glanavon Neptune (3959)
Murray Judy	Guernsey	9119	15-8-38	16-8-41	273	8	6,279	5·39	338·61	R. J. Giles	Drakesbrook Larwood (4032)
Wooroloo Dainty 3rd	A.I.S.	....	2-1-39	21-8-41	273	23	8,289	4·08	338·24	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Grass Vale Twylish Lady	Jersey	76604	14-10 38	18-8 41	273	19·5	6 004	5·46	328·09	R. H. Rose	Grass Vale Gold Boy (14684)
Glanavon Pink Pearl 3rd	A.I.S.	....	9-11-38	21-8-41	273	23	8,199	3·88	318·23	D Bevan & Sons	Parkview Commodore (306)
Yanget Pretty Maid 2nd	do.	28697	28-10-37	23 10 40	273	19	6,897	4·57	315·67	W. G. Burges	Sunrise of Parkview (1875)
Chittering Fancy	do.	....	20-10-38	20-7 41	273	15	7,327	4 21	308·59	G. W. Marston	Brackenhurst Conquest (4624)
Glanavon Fairy 3rd	do.	..	21-4-38	18 3-41	273	29·5	6,317	4 87	307·80	D Bevan & Sons	Blacklands Jean's Supreme (1871)
Wooroloo Heather 2nd	do.	28644	6-11-38	4-8-41	273	15	7,020	4·22	296·79	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Wooroloo Poppy 4th	do.	28654	12 4-38	25-10-40	273	24	7,032	4·16	292·15	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Brookfields Baroness	Guernsey	8376	4-8-38	18-6-41	273	14·5	6,074	4·65	282·33	P. G. Hampshire & Son	Brookfields Baron (3936)
Glanavon Buttercup 2nd	A.I.S.	..	18-6-38	21-4-41	273	18	6,384	4·39	280·38	D. Bevan & Sons	Parkview Commodore (306)
Wooroloo Doreen 2nd	do.	28637	8-4-38	29-10-40	273	21	6,573	4·22	277·43	Wooroloo Sanatorium Farm	Glanavon Genius (3957)
Juadine Jewel	Jersey	..	9 10-38	25-9-41	273	15	5,250	5·23	276·65	Miss L. G. Hancock	Austral Park Wonderful Standard (12423)
Brookfields Pamela	Guernsey	8387	22-8-38	20 5-41	273	15	5,340	5·11	272·62	P. G. Hampshire & Son	Brookfields Baron (3936)
Crantock Primula's Tulip	Jersey	70900	15-3 38	3-12-40	273	13	4 959	5·50	272·21	Mrs. G. H. Burnside	Conzelin Eminent's Golden (13623)
Wooroloo Wendy 3rd	A.I.S.	..	27-9 38	17 8-41	273	17	6,231	4·32	264·25	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Greenmount Marinora's Model 2nd	Jersey	76623	27-5 38	12-5-41	273	9	4.445	5·73	254·63	A. G. Scott	Bellefaire Bonaparte's Bonetienne (9224)
Wooroloo Fussy	A.I.S.	28641	27-3 38	15-10-40	273	21	6,123	4·12	252·61	Wooroloo Sanatorium Farm	Wooroloo Melba's Triumph (4491)
Crantock Cream Countess	Jersey	.	20-8-38	2-5 41	273	9	4,347	5·62	244·31	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Wooroloo Wendy 2nd	A.I.S.	....	27-9-38	10 7 41	273	13	5,529	4·41	243·72	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Wooroloo Jewel	do.	....	20-11 37	27-10-40	240	12	5,190	4·38	227·04	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)
Greenmount Marinora 4th	Jersey	76622	30-7-38	29 6-41	210	7	4.733	4·75	224·88	A. G. Scott	Bellefaire Bonaparte's Bonetienne (9224)
Narrogin Maisie	A.I.S.	..	1-11 38	1-6-41	273	18	5,844	3·82	223·31	Narrogin School of Agriculture	Wooroloo Stirling 3rd (3626)
Claremont Mabel 15th	do.	....	29-1 39	8-9-41	273	21	5,823	3·81	222·15	Claremont Hospital for Insane	Claremont Max Hero (3802)
Brookfields Queen 5th	Guernsey	6842	15-4-38	8-12-40	273	12	4.155	4·97	206·65	W. Darnell	Brookfields Baron (3936)
Rosella Bonny Lass	do.	9309	10-10 38	5-7-41	180	16·5	3,630	5·66	205·37	W Darnell	Brookfields Baron (3936)
Namder Princess	Jersey	....	24-9-39	13 7-41	273	6	2.988	6 24	186·54	H. S. Reiman	Crantock Starbright's Napoleon (14551)
Greenmount Marinita's Marvel	do.	76621	30-10-38	24-5 41	150	25	3.570	4·88	174·24	A. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Rosella Joy	Guernsey	9311	10-7-38	7-7-41	150	22	3,469	4·88	169·26	W Darnell	Brookfields Baron (3936)
Crantock Napoleon's Petunia	Jersey	....	19-6 38	27 3-41	150	18	2.940	4·63	136·20	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Glanavon Eva 2nd	A.I.S.	....	20-6-39	29-3-42	30	33	990	3·98	39·42	D. Bevan & Sons	Blacklands Jean's Supreme (1871)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk Last Day of Test.	Weight of Milk for Period.	Average Test.	Weight of Butter Fat for Period.	Owner.	Sire.
COWS 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LB. BUTTER FAT.						lb.	lb.	%	lb.		
Glanavon Dahlia 7th	A.I.S.	....	23-3-38	2-9-41	273	35	13,035	4·41	575·57	D. Bevan & Sons	Glanavon Neptune (3059)
Capel Lottie	do.	....	5-8-38	3-10-41	273	19	12,942	4·10	530·68	B. W. Prowse	Leyland's Reward (3331)
Koojan Ideal's Delphinium	Guernsey	8809	13-9-38	22-9-41	273	22	9,096	5·25	478·05	A. W. Padbury	Glenburnie Ideal (2548)
Glanavon Picture 4th	A.I.S.	....	16-7-37	16-1-41	273	36	11,508	3·81	438·74	D. Bevan & Sons	Parkview Commodore (306)
Glanavon Dell 4th	do.	....	23-3-38	22-7-41	273	24	10,437	4·03	420·43	D. Bevan & Sons	Glanavon Elliott (3955)
Denmark Angeline	Guernsey	6956	4-7-37	1-11-40	273	21	7,173	5·82	417·37	Denmark Research Station	Koojan Golden Prosper (2283)
Namder Pet*	Jersey	68206	11-11-36	18-12-39	273	22·5	7,748	5·30	410·86	H. Redman	Ventonia Elvira's Masterpiece (13325)
Denmark Golden Glory	Guernsey	6965	13-5-38	10-9-41	273	18	6,924	5·40	374·22	Denmark Research Station	Denmark Damon (2519)
Grantham Air Lady 4th	Jersey	66770	1-4-38	1-8-41	273	9	6,177	6·03	372·68	J. A. Sears	Greenmount Black Prince (6511)
Tipperary Dove 10th	A.I.S.	....	25-3-38	31-3-41	273	17	8,751	4·70	371·73	W. G. Burges ..	Blacklands Monarch's Commander (1877)
Grass Vale Golden Eve	Jersey	76601	23-6-38	24-7-41	273	11	6,723	5·53	371·58	R. H. Rose	Grass Vale Gold Boy (14684)
Wooroloo Empress 2nd	A.I.S.	28639	24-11-37	7-4-41	273	8	7,974	4·34	346·37	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Tipperary Dove 9th	do.	....	2-10-37	29-12-40	273	20	7,800	4·40	343·33	W. G. Burges ..	Blacklands Monarch's Commander (1877)
Brookfields Morden Lady 2nd	Guernsey	6838	19-9-37	20-2-41	273	21	6,363	5·38	342·37	P. G. Hampshire & Son	Koojan Ace's Majestic (2735)
Muresk Gloria	do.	7636	28-5-38	10-6-41	273	14	5,832	5·86	342·19	Muresk Agricultural College	Muresk Homestead (2075)
Denmark Pink Rose	do.	6969	24-7-38	11-9-41	273	12	6,036	5·56	335·97	Denmark Research Station	Denmark Auric (3313)
Murray Anne	do.	7653	28-6-38	24-8-41	273	14·5	6,013	5·49	330·16	P. G. Hampshire & Son	Drakesbrook Larwood (4032)
Grantham Starbright's Queen 4th	Jersey	66778	3-5-38	7-8-41	273	10·5	6,376	5·10	325·20	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Coogely Jonquil	Guernsey	6945	1-11-37	26-4-41	273	10	5,130	6·21	318·58	Denmark Research Station	Coogely Judy's Goldmine (2621)
Glanavon Sylvia 2nd	A.I.S.	....	23-4-38	19-7-41	273	20	7,875	3·95	310·86	D. Bevan & Sons	Parkview Commodore (306)
Muresk Guinevere	Guernsey	7638	15-5-38	5-6-41	273	13	6,009	5·16	309·57	Muresk Agricultural College	Denmark Auric (3313)
Brookfields Honour	do.	6836	8-9-37	6-11-40	273	17	5,496	5·45	299·51	P. G. Hampshire & Son	Koojan Ace's Majestic (2735)
Juadine Juliet 10th	Jersey	....	12-3-38	20-8-41	273	13	5,799	5·15	299·07	Miss L. G. Hancock	Austral Park Wonderful Standard (12423)
Ferndale Jean 6th	A.I.S.	....	10-1-38	22-3-41	273	23·5	7,706	3·84	295·89	G. W. Marston	Tabbagong Hinkler (261)
Yanget Pretty Maid 3rd ..	do.	....	8-7-38	2-8-41	273	15	6,015	4·56	274·68	W. G. Burges	Sunrise of Parkview (M.S.) (1875)
Coogely Heiress	Guernsey	6944	15-5-37	30-10-40	273	11	4,368	5·12	223·50	P. G. Hampshire	Coogely Judy's Goldmine (2621)
The Wold Fairy Pride	Jersey	....	15-4-38	11-5-41	210	5	3,825	5·49	210·36	L. C. Field	Grantham Fairy King (13765)
Greenmount Charming Queen 2nd	do.	71652	16-3-38	4-5-41	180	21·5	3,990	5·03	200·85	A. B. Strempel ..	Bellefaire Bonaparte's Bonetienne (9224)
Claremont Cherry 14th	A.I.S.	....	23-10-37	16-3-41	210	26	5,310	3·78	200·70	Claremont Hospital for Insane	Claremont Max Hero (3802)

Narrogin Mabel	do.	....	25-11-37	4-4-41	273	16	5,395	3·44	184·96	Narrogin School of Agriculture	Wooroloo Stirling 3rd (3626)
Tipperary Dove 12th	do.	28222	10-8-38	14-10-41	210	7	4,110	4·32	177·87	W. G. Burges	Newstead Tourist (3419)
Rosella Lady Luck	Guernsey	9313	28-7-38	29-8-41	120	23	2,985	5·20	155·88	W. Darnell	Brookfields Baron (3936)
Glanavon Mayflower 2nd	A.I.S.		1-8-38	10-11-41	60	35	2,400	3·90	93·60	D. Bevan & Sons	Parkview Commodore (306)
Narrogin Cherry	do.		28-1-38	2-4-41	60	35	2,160	3·95	85·32	Narrogin School of Agriculture	Wooroloo Stirling 3rd (3626)

COWS 3½ YEARS AND UNDER 4 YEARS—STANDARD 290 LB. BUTTER FAT.

Glanavon Tiny 5th	A.I.S.		23-10-37	22-9-41	273	44	14,322	4·27	612·11	D. Bevan & Sons	Parkview Commodore (306)
Koojan Bo Peep 2nd	Guernsey	7246	2-4-37	29-1-41	273	33	9,639	5·69	548·93	A. W. Padbury	Koojan Ace's Aristocrat (2730)
Glanavon Ettie	A.I.S.		25-2-37	24-10-40	273	46	11,298	4·48	505·52	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Glanavon Rosina	do.		3-5-37	9-12-40	273	34	10,392	4·85	503·54	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Glanavon Gold 4th	do.		19-10-37	23-7-41	273	23	10,089	4·61	465·76	D. Bevan & Sons	Glanavon Neptune (3959)
Glanavon Mayflower	do.	25184	22-4-37	26-2-41	273	34	11,082	3·91	433·35	D. Bevan & Sons	Parkview Commodore (306)
Denmark Bonny Mary	Guernsey	6958	30-9-37	27-7-41	273	17	7,641	5·55	424·44	Denmark Research Station	Denmark Illustrious (3320)
Glanavon Charmer	A.I.S.		24-4-37	19-12-40	273	25	9,645	4·39	423·99	D. Bevan & Sons	Parkview Commodore (306)
Brookfields Morden Lady 3rd	Guernsey	6839	27-9-37	2-9-41	273	19·5	7,461	5·21	389·00	P. G. Hampshire & Son	Koojan Ace's Majestic (2735)
Muresk Sultana	do.	7650	6-7-37	27-3-41	273	21	7,758	4·96	385·74	Muresk Agricultural College	Koojan Ace's Goldseeker (3431)
Wooroloo Wendy	A.I.S.		2-10-37	9-7-41	273	22	9,396	3·98	373·53	Wooroloo Sanatorium Farm	Glanavon Genius (3957)
Wooroloo Heather	do.	23247	5-11-37	14-8-41	273	10	8,970	3·93	353·05	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Brookfields Bess	Guernsey	6832	8-9-37	13-7-41	273	16	6,093	5·68	346·55	P. G. Hampshire & Son	Koojan Ace's Goldseeker (3431)
Grass Vale Design's Maggie	Jersey	71637	25-11-37	4-8-41	273	10	6,195	5·53	342·41	R. H. Rose	Grass Vale Gold Boy (14684)
Yanget Pretty Maid 2nd	A.I.S.	28697	28-10-37	14-10-41	273	16	7,578	4·49	340·78	W. G. Burges	Sunrise of Parkview (M.S.) (1875)
Crantock Napoleon's Daffodil	Jersey	75813	22-10-37	11-7-41	273	6	5,568	5·64	314·00	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Wattle Creek Bell	A.I.S.		27-8-37	9-8-41	273	10	9,105	3·40	309·78	E. T. Thatcher	Yanget Autumn Sun (3630)
Namder Daphne	Jersey	68205	27-10-36	27-10-40	273	10	5,250	5·89	309·61	H. S. Redman	Ventonia Elvira's Masterpiece (13325)
Tipperary Fairy 4th	A.I.S.	28223	27-11-37	7-9-41	240	13	7,080	4·26	302·25	W. G. Burges	Blacklands Monarch's Commander (1877)
Wattle Creek Mabel	do.	28488	23-7-37	6-6-41	240	11·5	7,965	3·75	298·77	E. T. Thatcher	Yanget Autumn Sun (3630)
Melbourne Lisette	Guernsey	7443	15-12-36	6-11-40	273	21·5	6,395	4·58	293·03	P. G. Hampshire	Woodlands Fleur-de-Lys (imp.) (2547)
Wooroloo Dessie	A.I.S.	23236	25-2-37	25-12-40	273	18	6,174	4·37	269·65	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)
Wattle Creek Reddy	do.		18-10-37	4-8-41	273	9	6,492	3·81	247·65	E. T. Thatcher	Yanget Autumn Sun (3630)
Glanavon Venus 3rd	do.		15-12-37	26-8-41	210	9	5,070	4·71	239·28	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Crantock Golden Bell	Jersey	70896	13-8-37	18-7-41	180	16	4,800	4·78	229·74	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Crantock Golden Cream 3rd	do.		30-5-37	7-2-41	210	13	4,080	4·81	196·38	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Crantock Starbright's Napoleonette 2nd	do.	70902	5-7-37	8-2-41	150	17	3,495	5·14	179·76	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Grass Vale Design's Nora	do.	71638	8-8-37	28-5-41	120	22·5	3,000	5·59	167·64	R. H. Rose	Belgonia Design's Prince (14422)
Grass Vale Golden Cream 16th	do.	71639	28-8-37	18-6-41	90	22	2,295	4·38	100·53	R. H. Rose	Belgonia Design's Prince (14422)

COWS 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LB. BUTTER FAT.

Tipperary Fairy 3rd	A.I.S.	22905	1-9-36	9-1-41	273	27	11,721	4·23	495·76	W. G. Burges	Blacklands Monarch's Commander (1877)
Glanavon Sadie 2nd	do.	25192	9-2-37	29-2-41	273	35	9,435	4·38	414·94	D. Bevan & Sons	Glanavon Nimrod (437)
Glanavon Florrie	do.	....	24-2-37	24-4-41	273	19	9,207	4·44	408·65	E. T. Thatcher	Glanavon Nimrod (437)

* Omitted from last year's results.

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk Last Day of Test.	Weight of Milk for Period.	Average Test.	Weight of Butter Fat for Period.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS 4 YEARS AND UNDER 4½ YEARS—STANDARD 310 LB. BUTTER-FAT—*continued.*											
Wattle Creek Vera	A.I.S.	...	10-10-36	29-3-41	273	16	8,898	4·57	406·40	E. T. Thatcher	Wooroloo Duchess' Guardian (3621)
Glanavon Gold 3rd	do.	...	24-8-36	23-10-40	273	23	9,759	4·09	399·89	D. Bevan & Sons	Glanavon Le Nayler (3201)
Namder Pet	Jersey	68206	11-11-36	8-3-41	273	22	7,176	5·45	390·84	H. Reiman	Ventonia Elvira's Masterpiece (13325)
Wooroloo Sunbeam	A.I.S.	23273	24-10-36	21-2-41	273	24	8,742	4·31	377·03	Wooroloo Sanatorium Farm	Wooroloo Triumph 4th (3627)
Denmark Dawn Childe	Guernsey	6962	14-5-37	24-8-41	273	14	6,492	5·73	372·39	Denmark Research Station	Wollongbar Reformer (538)
Denmark Briar Rose	do.	6959	15-8-37	21-9-41	273	19	6,687	5·41	362·24	Denmark Research Station	Denmark Illustrious (3320)
Mokine Heroine 12th	Jersey	77794	15-5-37	30-6-41	273	15·5	7,817	4·62	360·93	H. A. Smith	Juading Chieftain (14759)
Crantock Silk Sox	do.	70931	6-6-37	2-7-41	240	9	6,390	5·23	334·35	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Wooroloo Betty 5th	A.I.S.	23232	8-1-37	1-5-41	273	16	7,608	4·25	323·00	Wooroloo Sanatorium Farm	Triumph of Pine Creek (A.M.S.) (2515)
Grantham Easter Rye 6th	Jersey	66774	1-9-37	4-10-41	273	15	5,765	5·51	318·21	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Wattle Creek Venus 2nd	A.I.S.		28-8-37	16-9-41	273	17	7,911	3·94	312·15	E. T. Thatcher	Yanget Autumn Sun (3630)
Denmark Morning Glory	Guernsey	6967	21-6-37	1-8-41	273	10	4,815	5·46	263·15	Denmark Research Station	Denmark Damon (2519)
Grass Vale Nora Lady	Jersey	66788	1-12-36	28-3-41	180	17	4,395	5·83	256·71	R. H. Rose	Selsey Gay Boy (15134)
Tipperary Dove 8th	A.I.S.	22904	6-10-36	31-3-41	210	14	5,809	4·31	250·17	W. G. Burges	Blacklands Monarch's Commander (1877)
Muresk Joyous	Guernsey	7642	9-5-37	8-6-41	210	14	4,320	5·71	247·47	Muresk Agricultural College	Koolan Ace's Goldseeker (3431)
Brookfields Duchess	do.	6835	3-6-37	12-9-41	120	31·5	3,795	4·89	185·76	W. Darnell	Brookfields Majesty (3254)
Crantock Eminent's Sunshinette	Jersey	70895	7-1-37	7-4-41	180	18	3,600	4·88	175·59	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Westby Dahlia	A.I.S.	....	17-9-37	10-10-41	60	40	2,400	3·19	76·68	Burkitt & Brown	Telyarup Duke (956)
Yanget Gwen 2nd	do.	....	12-11-36	9-5-41	60	33	1,980	3·56	70·44	A. E. Grant	Leylands Defiance (2380)
COWS 4½ YEARS AND UNDER 5 YEARS—STANDARD 330 LB. BUTTER-FAT.											
Glanavon Melba	A.I.S.		21-12-36	8-7-41	273	22	12,816	3·74	479·58	D. Bevan & Sons	Parkview Commodore (306)
Glanavon Gem 2nd	do.	...	19-10-36	6-8-41	273	10	10,545	3·99	420·87	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Glanavon Buttercup	do.	25158	4-5-36	22-2-41	273	20	8,757	4·78	418·54	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Tipperary Dove 5th	do.	22902	20-8-36	13-8-41	273	23	9,789	4·24	415·77	W. G. Burges	Blacklands Monarch's Commander (1877)
Wattle Creek Viola	do.	...	15-2-36	30-10-40	273	24	10,212	3·91	398·84	E. T. Thatcher	Tipperary Violet's Monarch (2876)
Glanavon Thelma	do.	25194	1-3-36	19-11-40	273	27	9,141	4·33	393·35	D. Bevan & Sons	Glanavon Nimrod (437)
Mokine Amy 4th	Jersey	68039	24-8-36	27-6-41	273	17	8,031	4·85	389·60	H. A. Smith	Mokine Repulse (5867)
Wooroloo Trixie	A.I.S.	23276	4-11-36	5-10-41	273	29	9,057	4·27	387·48	Wooroloo Sanatorium Farm	Park View Guardian (A.R.) (2557)

Glanavon Sunbeam 9th	do.	..	16-3-36	4-11-40	273	26	7,788	4·85	377·43	D. Bevan & Sons	Glanavon Nimrod (437)
Crantock Napoleon's Primula 3rd	Jersey	66068	21-6-36	11-2 41	273	20·5	6,257	5·33	333·81	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
The Wold Princess Daisy	do.	64561	7-8-36	16-4-41	240	10·5	5,310	6·03	320·16	L. C. Field	Grantham Air Prince 2nd (10657)
Glanavon Daphne 3rd	A.I.S.	25165	13-2-37	17-9-41	273	9	7,767	3·84	298·56	Burkitt & Brown	Parkview Commodore (306)
Muresk Desdemona	Guernsey	7633	31-5-36	8-5-41	273	14	6,102	4·76	290·55	Muresk Agricultural College	Muresk Homestead (2075)
Ferndale Jean 5th	A.I.S.	25082	16-1-37	31-7-41	273	4	6,957	3·69	256·92	G. W. Marston	Hinkler of Tabbagong (261)
Claremont Pinafore 5th	do.	....	19-10-35	10-10-40	240	13	7,260	3·40	247·17	Narrogin School of Agriculture	Claremont Kandor (1064)
Westby Polly 4th	do.	23145	30-3-36	30-3-41	273	14·5	6,374	3·59	229·53	Narrogin School of Agriculture	Telyarup Duke (A.R.) (956)
Wattle Creek Roany	do.	.	25 11-36	25 10 41	210	16	4,830	3·71	179·55	E. T. Thatcher	Wooroloo Duchess' Guardian (3621)
Yanget Della 3rd	do.	23296	1-4-36	6-1-41	180	20	5,310	3·28	174·32	A. E. Grant	Leylands Defiance (2380)

COWS 5 YEARS AND OVER—STANDARD 350 Lb. BUTTER-FAT.

Blacklands Ettie 9th	A.I.S.	9298	24-9-32	22-10 40	273	45	16,170	4·23	683·64	D. Bevan & Sons	Parkview Limelight (370)
Denmark Orangebud	Guernsey	4123	9-8-32	3-9 41	273	36	12,193	5·16	629·93	Denmark State Farm	Koojan Golden Prosper (2283)
Glanavon Tiny	A.I.S.	20212	25 9-34	8-5 41	273	30	14,970	4·15	621·57	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Koojan Ace's Jean	Guernsey	5660	10-3-36	3 5 41	273	31	9,933	6·06	602·31	A. W. Padbury	Homestead Ace (imp. U.S.A.) (1631)
Coogely Zonia	do.	5430	4 7 34	20 5-41	273	22	9,216	6·01	553·58	R. J. Giles	Koojan Forty Winks (2738)
Tabbagong Dove 11th	A.I.S.	14421	22-7-43	1-5-41	273	29	13,497	4·09	552·66	W. G. Burges	Parkview Reward 2nd (260)
Wooroloo Poppy 2nd	do.	23265	4-5-35	8 5-41	273	28	12,894	4·24	546·36	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Denmark Golden Dawn	Guernsey	4118	9-1-33	21-6 41	273	21	7,863	6·39	503·13	Denmark Research Station	Koojan Golden Prosper (2283)
Selsey Attraction	Jersey	55203	16-7-34	5-8-41	273	18	7,539	6·59	497·39	W. H. & T. F. Robinson	Brampton Great Boy (imp.) (9137)
Wooroloo Flash 3rd	A.I.S.	23243	1-6-36	17 9 41	273	32	11,465	4·19	480·73	Wooroloo Sanatorium Farm	Parkview Guardian (A.R.) (2557)
Tipperary Maggie 4th	do.	18330	15-9-35	6 9 41	273	13	11,259	4·25	478·64	W. G. Burges	Blacklands Monarch's Commander (1877)
Melbury Rose	do.	.	29-4-34	28 9-41	273	21	12,303	3·87	477·33	B. W. Prowse	Telyarup Roosevelt (1538)
Crantock Napoleon's Duchess	Jersey	52399	11-1-34	16 2-41	273	28	7,854	5·98	469·85	H. S. Redman	Crantock Blonde's Napoleon (8207)
Denmark Orange Pekoe	Guernsey	5444	11-6-36	31-8 41	273	19	8,487	5·52	468·96	Denmark Research Station	Denmark Damon (2519)
Norric Peggy	A.I.S.	..	14-4-35	17-7-41	273	16	11,448	3·99	457·49	W. G. Burges	Warwick Rufus (3595)
Beauna Vista Fairy 5th	do.	1322	8-12-29	11 6-41	273	9·5	14,234	3·15	448·10	D. Bevan & Sons	Spearfelt of Alne Bank (I.M.S.H.B.) (1029)
Denmark Golden Marie	Guernsey	3873	26-4-32	9 6-41	273	8·5	7,481	5·97	446·41	Denmark Research Station	Koojan Golden Prosper (2283)
Denmark Prosper's Rosa	do.	4127	27-12-32	6-6-41	273	20	7,860	5·66	445·30	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Empress	A.I.S.	23241	1 11-35	21-5-41	273	27	10,671	4·11	438·14	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Leylands Melba	do.	17170	1-9-33	16-11-40	273	12	9,576	4·49	429·68	D. Bevan & Sons	Widgee Wan Record (848)
Wooroloo Freda 2nd	do.	23245	9 10-35	9-5-41	273	26	10,398	4·09	425·43	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Juadine Peerless Lily 9th	Jersey	62336	27 9 35	4 11-40	273	17·5	7,171	5·91	424·16	Miss L. G. Hancock	Juadine Sunshine (8212)
Wooroloo Milkmaid 5th	A.I.S.	15339	2-1-34	6-7-41	273	15·5	11,881	3·54	421·71	E. T. Thatcher	Parkview Guardian (2557)
Brookfields Charity	Guernsey	5320	27-1-36	3 10 41	273	15	6,720	6·25	420·39	P. G. Hampshire & Son	Koojan Ace's Majestic (2735)
Glanavon Dahlia 3rd	do.	....	9-11-35	29-12 40	273	28	9,714	4·31	418·22	D. Bevan & Sons	Parkview Commodore (306)
Denmark Rosette	do.	6972	21 7-36	11 9-41	273	16·5	6,994	5·97	418·13	Denmark Research Station	Koojan Golden Prosper (2283)
Koojan Ace's Dulcie	do.	5658	6-3-36	11-3-41	273	21	6,963	5·82	405·20	Denmark Research Station	Homestead Ace (imp.) (1631)

HERD TESTING—*continued.*

COWS 5 YEARS AND OVER—STANDARD 350 LB. BUTTER-FAT—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Weight of Milk Last Day of Test.	Weight of Milk for Period.	Average Test.	Weight of Butter Fat for Period.	Owner.	Sire.
						lb.	lb.	%	lb.		
Wooroloo Bonnie	A.I.S.	18626	29 10–34	29 4–41	273	16	9,978	4·05	404·37	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Glanavon Bluebell	do.	25157	1 3–36	9 5 41	273	16·5	9,410	4·29	403·43	G. W. Marston ..	Glanavon Nimrod (437)
Glanavon Esmeralda	do.	6728	24–9 31	19–10 40	273	21	9,183	4·38	402·27	D. Bevan & Sons ..	Villiers of Darbalara (2386)
Wooroloo Lady Betty	do.	18634	3–8 34	29 1 41	273	28	9,054	4·34	393·23	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Glanavon Dahlia 4th ..	do.	....	4 3–36	26 4–41	273	14	10,512	3·71	389·80	E. T. Thatcher	Parkview Commodore (306)
Grantham Easter's Felicity	Jersey	57555	18 9 35	6–8–41	273	12	6,426	6·02	387·06	J. A. Sears	Greenmount Black Prince (6511)
Claremont Cherry 9th	A.I.S.	15955	25 11–34	7 4–41	273	24	9,562	3·98	382·16	Narrogin School of Agriculture	Tipperary Virginia's Re-echo (970)
Tipperary Lady May 2nd	do.	18328	8 10 35	16 2 41	273	21	8,898	4·19	372·75	W. G. Burges ..	Blacklands Monarch's Commander (1877)
Wooroloo Moss Rose 4th	do.	23259	22–4 35	20 12 40	273	23	7,809	4·69	366·53	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Colmyn Brown Maggie	Jersey	56859	27 6–35	21 9–41	273	22	7,071	5·13	363·24	Miss L. G. Hancock	Colmyn Prince Victor (10492)
Greenmount Golden Wonder	do.	61975	28 3–35	21–6 41	273	8·5	6,964	5·21	363·12	A. G. Scott	Bellefaire Bonaparte's Bonetienne (9224)
Blacklands Buttercup 6th	A.I.S.	9282	6 11 32	17–10 40	273	19	7,437	4·84	360·16	D. Bevan & Sons ..	Orama of Blacklands (A.M.S.) (1905)
Juadine Juliet 8th	Jersey	44518	10–10–32	3–3–41	273	23	7,214	4·99	359·69	Miss L. G. Hancock ..	Juadine Radiance (7598)
Wooroloo Fairy 2nd	A.I.S.	18631	3 12 34	14–5 41	273	17	8,766	4·09	359·22	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Wooroloo Dell	do.	18628	18–10 34	7 4 41	240	29	8,970	3·96	354·81	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Wooroloo Yvonne	do.	18639	25 2–35	25–12–40	273	27	8,631	4·09	353·57	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Leylands Queen	do.	1775	2–8 33	29 6 41	273	14	10,582	3·33	352·34	G. W. Marston	Parkview Commodore (306)
Glanavon Dahlia	do.	10921	1·5–33	26–10 40	273	10	7,620	4·62	352·22	D. Bevan & Sons ..	Villiers of Darbalara (2386)
Hillview Minnie 9th	do.	4502	23–10–30	7–6–41	273	13	10,059	3·50	352·10	G. W. Marston ..	Limelight of Hillview (I.M.S.) (954)
Brookfields Morden Lady	Guernsey	5330	10–10–34	8 3 41	273	24	6,651	5·23	347·96	P. G. Hampshire & Son	Koojan Lord Barklay (1031)
Milbank Joan 5th	A.I.S	7411	12–1 32	3–7–41	273	23	9,579	3·59	343·91	G. W. Marston ..	Parkview Ruler (309)
Juadine Sparkle 13th	Jersey	67233	15–5–35	3–6–41	240	15	5,595	6·13	343·05	H. A. Smith	Juadine Robin (11751)
Greenmount Flash Maid	do.	61972	28–1 36	4 4–41	273	11	6,401	5·24	335·22	A. G. Scott	Greenmount Golden Flash (12736)
Muresk Rosebud	Guernsey	4732	4 7 33	5 4–41	273	15	6,405	5·17	330·90	Muresk Agricultural College	Minnamurra Plaintiff (1318)
Brookfields Bonnie Blossom	do.	5319	15–8 34	11–4–41	240	24	6,495	5·06	328·74	P. G. Hampshire & Son	Koojan Lord Barklay (1031)
Wooroloo Kitty 3rd	A.I.S.	23253	9–7–35	3–3 41	273	20	7,830	4·08	319·66	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Greenmount Marinette	Jersey	34840	24–5 31	25–5 41	273	7	6,696	4·67	313·07	A. G. Scott	Grantham Starbright's King (5796)
Muresk Lady Fair	Guernsey	4729	20–9–32	28–4 41	273	14	6,672	4·68	312·65	Muresk Agricultural College	Triumph of Wollongbar (513)
Brookfields Lady Hope	do.	5325	14–9–34	25 11–40	273	23·5	6,641	4·67	310·09	W. Darnell	Koojan Lord Barklay (1031)

Greenmount Golden Lass ...	Jersey	71653	30 9 36	6-10-41	240	15·5	5,602	5·49	307·80	A. G. Scott	Belletaire Bonaparte's Bonetienne (9224)
Westby Polly	A.I.S.	15141	21–5–32	3–4–41	273	10	7,302	4·21	307·63	Narrogin School of Agriculture	Telyarup Duke (956)
Greenmount Sweet Lass	Jersey	44204	14–7–33	14 9–41	240	12	5,415	5·03	287·61	A. G. Scott	Belletaire Bonaparte's Bonetienne (9244)
Brookfields Primrose	Guernsey	5331	24 2–35	25–4 41	240	17	5,520	5·18	286·11	W. Darnell	Koojan Ace's Majestic (2735)
Chittering Diana	A.I.S.	19575	7 7–35	27–11–40	210	19	6,270	4·38	274·98	Narrogin School of Agriculture	Range Sultan (1535)
Brookfields Lady Lynette	Guernsey	5327	21–7–34	17–2–41	273	18	5,664	4·78	270·75	W. Darnell	Koojan Lord Barklay (1031)
Crantock Napoleon's Primula 2nd	Jersey	61211	7–7–35	7–2–41	210	15	4,605	5·77	265·86	Mrs. G. H. Burnside ...	Crantock Blonde's Napoleon (8207)
Claremont Flora	A.I.S.	15961	27–8–34	26 4–41	240	20	8,520	3·11	264 93	Narrogin School of Agriculture	Claremont Herdsman (968)
Tipperary Dinah	do.	18319	7–6–32	15–10–40	240	7	5,580	4·31	240·39	Narrogin School of Agriculture	Tipperary Twilight 2nd (444)
Muresk Tess	Guernsey	6066	15–5 35	7–11–40	273	13	5,169	4·63	239·51	P. G. Hampshire & Son	Muresk Homestead (2075)
Crantock Blonde's Susanette	Jersey	56951	28–10–32	12–2–41	210	14	3,870	5·94	229·98	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Leylands Champagne's Lovely	A.I.S.	12249	5–6–34	12–12 40	210	22	6,000	3·80	227·91	A. E. Grant	Thornleigh Champagne (930)
Glanavon Doris 2nd	do.	20200	30–8–34	19–11–40	150	29	5,670	4·00	226·92	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Yanget Victress	do.	18662	29–7–35	11 12–40	210	23	5,820	3·88	225·42	A. E. Grant	Sunrise of Parkview (1875)
The Wold Northwood Crescendo	Jersey	64559	16–4–36	18 6 41	180	7·5	3,630	5·63	204·48	L. C. Field	Grantham Air Prince 2nd (10657)
Grassvale Twylish Maggie	do.	53029	12–6–33	27–5–41	120	25·5	3,765	4·80	180·87	R. H. Rose	Banyule Silvermine Twylish (7600)
Tabbagong Beauty 19th	A.I.S.	7502	20–12–31	11–12–40	180	15	4,200	3·98	167·01	A. E. Grant	Parkview Reward 2nd (260)
Grass Vale Buttercup 2nd	Jersey	66779	22–8–35	29 5–41	120	20·5	2,835	5·79	164·04	R H. Rose	Spring Park Starbright's Sweet Duke (8221)
Wooroloo Moss Rose 4th ..	A.I.S.	23259	22–4–35	16–1–42	90	33	3,720	4·31	160·56	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Tabbagong Topsy 12th ...	do.	4472	18–12–29	25–12–40	210	29	5,190	3·05	158·07	A. E. Grant	Regent of Tabbagong (2618)
Greenmount Gentle Lady	Jersey	61973	8–8 35	26 8–41	60	40	2,610	5·93	154·86	A. B. Strempel	Belletaire Bonaparte's Bonetienne (9224)
Lansdowne Golden Hope 4th	Guernsey	8827	5–3–36	21–8–41	120	16	2,610	5·21	136·08	R. J. Giles	Koojan Ace (2270)
Blacklands Daphne 7th	A.I.S.	9291	18–10–32	8–4 41	90	36	3 060	3·34	102·12	A. E. Grant	Fussy's Monarch of Hillview (493)
Yanget Champagne's Lovely	do.	23294	2–5–36	11 6–41	30	37	1 110	4 36	48·42	A. E. Grant	Sunrise of Parkview (I.M.S.) (1875)

Pollen-Containing Sprays for the Cross-Pollination of Ohanez Grapes.

by

T. C. Dunne.

Cross-pollination of the Ohanez (Almeria) grape has been practised in Western Australia for many years. Dependence on inter-planting with other varieties and wind pollination did not achieve the desired result so that growers of this variety have resorted to hand pollination.

The normal procedure to ensure setting is to rub each bunch as it flowers with a sprig taken from a flowering bunch of another variety. This entails inspection of all Ohanez vines at least every three days during the flowering period when, by means of the rubbing already mentioned, pollen is placed on the bunches considered to have reached a stage of flowering suitable for pollination. Obviously, considerable labour is needed to insure satisfactory fertilisation and setting.

In 1939, spraying with a suspension of pollen in water was initiated by two growers at West Swan, Mr. A. R. Stevens and Mr. A. H. Convoy, as a means of reducing the cost of cross-pollination. Flowering bunches of varieties used for cross-pollination were agitated in water until a yellow colour caused by suspended pollen grains was observed. This mixture was then transferred to an atomiser of one quart capacity and the flowering bunches of Ohanez grapes were sprayed. The experimenters were convinced that successful setting resulted from this spraying.

In order to help establish the value of this method of cross-pollination, controlled investigations were begun in 1940. Using bagged and unbagged Ohanez bunches, an attempt was made to compare the setting from spraying with pollen in water with that from rubbing. As a check on the spraying, a further group of bunches were sprayed with water. A number of controls receiving no treatment were also included in the experiment.

Owing to causes yet not discovered, an extremely large number of small unfertilised berries or "chickens" occurred on all bunches treated during the period over which the work was done, irrespective of whether they were rubbed or sprayed. No yield data were therefore obtained, but the following observations were made.

(a) Where no pollination treatment was given, no set occurred with the bagged bunches and a neglible set occurred on the unbagged material.

(b) Spraying with water only gave the same result as occurred with no treatment.

(c) Better setting both from spraying with pollen and rubbing occurred on the bagged bunches than on the bunches not bagged. No reasonable explanation for this fact has been found.

1941-42 *Experiments.*

Further data on various aspects of the work was obtained the following season.

Need for Cross-Pollination.

It has been thought possible that the inability of the Ohanez grape to self pollinate may have been due to the fact that, at the time the stigma is receptive, the stamens are reflexed. A small test was made to determine definitely the need for cross-pollination.

Selected bunches in the pre-flowering stage were bagged. As flowering occurred some bunches were rubbed with flowering sprigs of Ohanez, some with sprigs of another variety and the remainder left untouched. Following are the results:—

Treatment.	Setting.
(a) Nil.	Nil.
(b) Rubbed with Ohanez	Nil.
(c) Rubbed with Purple Cornichon	Excellent.

Where no setting occurred the bunches usually fell from the canes. The results showed the necessity for cross-pollination and indicated that the inability of the Ohanez grape to self-pollinate was not due to the reflexion of the stamens.

It is of interest, however, that the Bridal (or late Valensy) grape which also has reflexed stamens, is almost useless for cross-pollinating Ohanez. Evidence procured during the past season shows the need too, for the cross-pollination of Bridal grapes to insure satisfactory setting.

Methods of Cross-Pollination.

The second attempt to compare methods of cross-pollination was more successful. The work reported in detail was conducted on Mr. Steven's vineyard where the vines which are relatively young and highly productive are trained on an overhead trellis.

Twenty bunches in the pre-flowering stage were taken at random and bagged for each of the following treatments:—

(a) Sprayed with pollen in water.
(b) Rubbed.
(c) Rubbed and subsequently thinned.

The third treatment was included because of the fact that under commercial conditions a heavy set is usually aimed at, in order to insure that sufficient berries are set. The set bunches are later thinned, otherwise with normal growth they would be much too tight for export purposes. It was considered that in the event of the setting from the spray being inferior to that from rubbing, it still might compare favourably in eventual yield with the thinned bunches. The actual set from spraying was, however, observed to be so good that comparison with the thinned bunch was not necessary and two sets of figures for yields of rubbed bunches are tabulated below.

For the preparation of the sprays, bunches of Black Malaga grapes in full bloom were collected. These were placed in a container and lightly pressed down by hand. To this material was added water to occupy about double the volume originally occupied by the flowering bunches. The flowers were then agitated thoroughly and the resultant suspension was filtered through a fine wire gauze. The concentration of pollen grains was about 30,000 per cubic centimetre, which is equivalent to about 17 million per pint.

The bagged bunches were inspected every day and as flowering began were either sprayed until wet or rubbed. These treatments were continued until flowering ceased. In commercial practice, daily attention is not normally given with the rubbing method, but in this experiment the aim was to achieve maximum setting. About two weeks after flowering ceased the bags were removed, and the bunches allowed to develop normally.

Harvesting of the fruit was done about five months later where full maturity had been reached. Owing to the luxuriant foliage, not all the treated bunches were located. Following are the yield data:—

A. *Bunches bagged during pollination—*

Treatment.	No. of bunches.	Yield. lb.	Percentage of rubbed control (a).
Sprayed with pollen in water ..	18	45	110
Rubbed (a)	17	38½	100
Rubbed (b)	19	38	88

A similar series was done with unbagged bunches. Obviously accidental pollination could and probably did occur to some extent through the carrying of the spray by wind and through other agencies. However, the data were obtained to determine whether under more natural conditions, the results were substantially the same as were obtained with the bagged material.

B. *Bunches not bagged during pollination—*

Treatment.	No. of bunches.	Yield. lb.	Percentage of rubbed control (a).
Sprayed with pollen in water ..	17	35½	93
Rubbed (a)	16	36	100
Rubbed (b)	17	35	92

With both the bagged and unbagged material, the rubbed bunches used as controls were, at maturity, much too tight for commercial purposes and, under normal practice, would have been heavily thinned a few weeks after setting. From the results quoted, allowing for obvious variability, it is evident then that satisfactory commercial setting was achieved by the spraying method.

A smaller comparison of rubbing and spraying methods was conducted on low trellis on another property. No yield data were collected but, in this instance also, it was obvious that excellent setting comparable with that from rubbing was obtained from the spray method of pollinating.

Methods of Spraying.

To obtain further information for the practical application of the spraying method of pollination experiments were conducted to determine—

(a) the best method of spraying, i.e., as a fine mist or by wetting the bunches thoroughly;

(b) the concentration of pollen grains needed in the spray.

In these experiments the atomiser was used for all spraying. For the mist it was operated 18-24 inches away from the bunches and the fine spray allowed to float towards the flowers. For the wetting, the atomiser was held close to the bunches. With wetting, two concentrations of pollen grains were used, the more concentrated about 30,000 grains per cubic centimetre and the weaker about 3,000 grains. The following results were obtained:—

Bunches not bagged—

Method.	No. of bunches.	Yield. lb.	Percentage of rubbed control.
Mist of conc. spray	17	25	71
Wetted with conc. spray	15	34	109
Wetted with weak spray	12	13	52
Rubbed	18	37½	100

In this experiment again, the more heavily setting methods resulted in bunches too tight for commercial purposes. Actually sufficient berries were set on the bunches pollinated with the mist spray, as with that amount of setting most thinning could be avoided. The use of the weak spray resulted in a considerably reduced yield. However, it is most probable that control of setting to avoid costly thinning could be best obtained by wetting the bunches together with adjustment of the concentration of the spray with respect to pollen grains. The most effective concentration would vary with the frequency of spraying and with the variety of grape from which the pollen is taken for cross-pollinating.

Behaviour of Pollen in water.

The pollen counts to which reference has been made were done by members of the Botany Department of the University of Western Australia. At the same time some observations were made of the behaviour of the pollen grains in water. As many as half of the grains of some varieties burst very quickly, but the remainder appeared to maintain good condition for some hours. It was also noted that with one variety, viz., Malbeck, the pollen grains showed some germination in water.

Until further data are obtained it is suggested that the pollen-water mixture be used for spraying within a few hours of mixing.

Practical Aspects.

The spraying method of pollination, when done with small atomisers, has been much better suited for vines on overhead trellis than on low trellis. In the latter case, the canes must be pulled back to expose the flowering bunches and as both hands of an operator are needed to use the atomiser, much time is lost.

During the past season, however, Mr. Stevens, whose vines are overhead, has successfully used a knapsack sprayer. This sprayer is fitted with a rod extension with a shut-off valve which has a lever release. Pressure is maintained in the sprayer and when a bunch in a stage of flowering suitable for pollination is sighted, pressure on the lever allows of a small jet of spray being directed at the bunch which is thus thoroughly wetted. With a shorter rod, the use of the knapsack sprayer should overcome the difficulties previously encountered on the low trellis.

Not only is there a saving in labour where spraying is practised, but it has been found that this method is most economical of pollen of the varieties used for cross-pollination. This is important at periods when pollen supplies are low.

SUMMARY.

The value of spraying with pollen suspended in water for the cross-pollination of Ohanez grapes is established. The assumed need for such cross-pollination for setting is confirmed.

Data are given which indicate that thorough wetting of the flowering bunches offers the most practicable method of application. The data suggest too, the possibility of some measure of control of setting by the adjustment of the concentration of pollen grains in the water.

ACKNOWLEDGMENT.

In addition to the acknowledgments made in this paper, further thanks for assistance are due to Mr. A. R. Stevens and to Messrs. Barrett-Lennard, on whose vines the experiments reported were conducted.

Introduction of Queen Bees.

L. Blair, Government Apiculturist.

Whilst many methods of introducing queen bees are known, only those which have been proven either by the author or by practical bee-keepers of this State and are simply applied, have been listed in these notes.

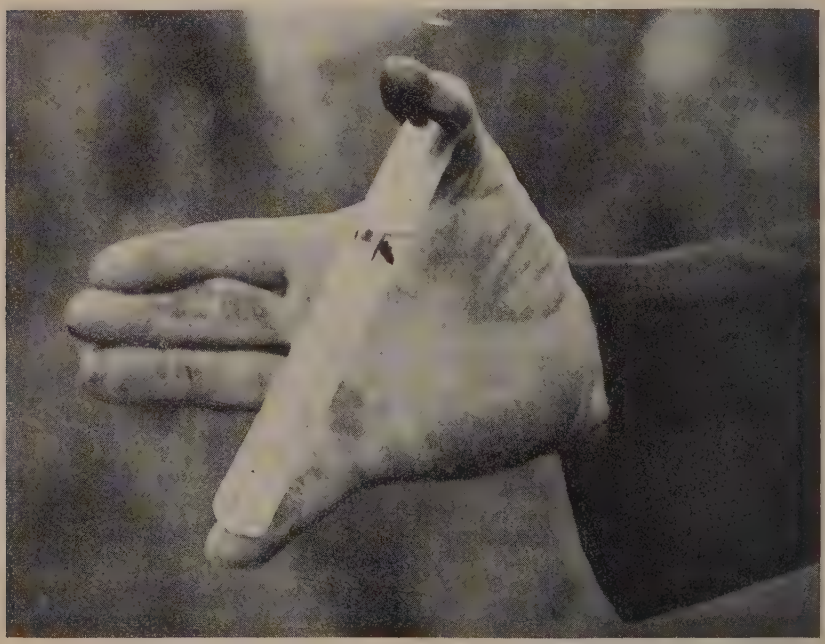
One is original, whilst the others are old methods which have been modified and improved.

The author himself has experienced the heartburning disappointment of a "miss" or failure when introducing a long awaited queen bee, but is confident that if one of the following methods is carried out correctly, the results will be all that could be desired.

Method No. 1.

This is a modification of a very old method of introducing the queen bee from the mailing cage.

After killing or removing the old queen bee, which should take place 12 to 24 hours before being replaced by the new queen bee, smear the wire on the mailing cage with honey from the hive into which you are introducing the new queen bee,



Showing method of immersing Queen prior to introduction.

also make a hole through the candy and dribble a little honey from the same source into this hole. Place the queen cage above or between the brood frames and do not disturb the hive for six or seven days. The queen should have been released by then, accepted and laying. Always remember when introducing queen bees, that the object in view is to combine, or neutralise the two different odours

of the two different queens. The quicker this object is accomplished, the safer is the introduction, and consequently less delay in brood production is experienced, and this means a great deal when building up for a honey flow.

Operator placing Oil of Cloves on bottom board of hive.

No. 2, *A Direct Method.*

A direct method which gives very good results is to kill or remove the old queen in the hive or nuclei to be requeened, run the new queen into a short test tube—⅝ or ¾ inch in diameter—(do not use a smaller tube, as it is very difficult to get the queen out of a smaller tube) and into this tube pour a little luke-warm water—blood heat—and gently rock the tube up and down until the queen is thoroughly wet and beginning to show effects of immersion. Water may be sweetened with a little honey, if preferred. Pour the queen and water between centre brood combs and replace the lid smartly, as if the queen is not thoroughly wet, and her wings not clipped, she may fly. Rinse out the tube after every operation.

This is a very successful method—quick and direct.

No. 2a, Another Direct Method.

Another direct method is to kill or remove the old queen to be replaced, remove the centre comb from the brood chamber, place two or three drops of oil of cloves on the floor or bottom board—one drop near centre and one drop near rear—and replace the comb. Release the queen bee immediately by lifting up one corner of the wire of the queen cage, placing the cage between or over the frames. If you have watched the queen walk out of the cage, this may be removed immediately, making sure not to damage the queen by over-rapid replacement of the lid. With this method it is possible to watch the queen walk out of the cage before placing the cover on—even when one gets confidence the warning holds good.

Caution.—Should a very lively queen attempt to fly away when introducing, leave the lid off and allow the bees to fly about for a while. The errant queen bee probably will return and fly into the hive you are manipulating.

Should oil of cloves not be obtainable, the operation may be done with diluted eucalyptus, but greater care must then be taken, as if too much is used there is a danger of the bees swarming out. This is a method which is quick and effective for large commercial apiarists when introducing large numbers of queen bees.

Method No. 3.

The following method has been used by the author for many years, particularly with valuable queens. It is a little more trouble than the previous methods, but is practically 100 per cent. successful and does not necessitate removal or destruction of the old queen until the new queen is laying, which is of particular value should the old queen be difficult to find at the time, or her delivery be delayed.

First obtain an empty super and a double screen of fly wire, i.e., a framework of wood, half an inch thick, with fly wire on each side. This keeps the rival queens apart so that they will not damage each other. Remove two frames of hatching brood—*and it must be hatching*—and shake all the bees off, *also from the two frames of honey.* Place these four combs in an empty super. These operations may be carried out a day, or some hours prior to the arrival of the new queen, thus ensuring a fair number of young bees hatched and ready to welcome the new queen. The empty space from which frames have been lifted may now be filled up with frames fitted with full sheets of foundation, or drawn out combs, if so desired. Next place the screen on top of the hive, then place the super containing the two frames of brood and two of honey on top of the screen, and release the new queen on to the four combs. The newly hatching bees in a few hours will be ample to keep the new queen company. The heat rising from the hive under the screen will keep all the inmates warm, and the young bees will accept the new queen without any demur. Provided that she has not received any injury in transit she should give good service, and in a few days the old queen may be removed and the whole united, but it is essential first to see that the new queen is laying and has a suitable number of bees in super. If preferred, the super containing the new queen may be removed, placed in a new position and built up quickly with an additional frame or two of hatching brood from time to time. It is advisable not to give too much brood before there are sufficient bees to cover it and keep it warm, otherwise the brood will get chilled and die.

Of course there are many more methods, but the foregoing have been tested extensively, and proved, and the author is confident that they will give every satisfaction to either the big commercial man, or the man who keeps bees as a hobby.

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Thanks are due to acquaintances too numerous to specify, for assistance and advice given over many years and it is assumed that these men who have behind them the experience of a lifetime of bee-keeping, will concur in my desire to pass on a little of this knowledge to the less fortunate.

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Contents.

		Page
THREE FERTILISER EXPERIMENTS WITH POTATOES ...	L. J. H. Teakle and E. T. Morgan	219
FOOTROT IN SHEEP	N. Davenport and F. Gishubl	227
WILD FLAX	C. A. Gardner	231
NOTES ON PLANT DISEASES	W. P. Cass-Smith	
1. THE CONTROL OF LOOSE SMUT OF WHEAT ...	... ...	236
2. GERMINATION OF PEAS IMPROVED BY DUSTING WITH COPPER CARBONATE	... ...	239
3. FLAX RUST	... ...	240
EXPERIMENTS WITH MICRO ELEMENTS FOR THE GROWTH OF CROPS IN WESTERN AUSTRALIA	L. J. H. Teakle	242
THE CENTRIFUGAL CREAM SEPARATOR	J. T. McNally	253
BERKHEYA OR HAMELIN THISTLE	G. R. W. Meadly and A. B. Cashmore	255
GREEN MANURES AND COMPOST	G. H. Burvill and L. T. Jones	260
LEGUME INOCULATION	W. P. Cass-Smith and H. L. Harvey	264
GRADE HERD RECORDING	M. Cullity and R. A. Paul	267
NOTCHING OF DORMANT BUDS ON APPLE TREES	A. T. Gulvin	284
EARLY SUBTERRANEAN CLOVER PASTURES	A. B. Adams	285
YELLOW BURWEED	C. A. Gardner	289
THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION RECORDING SCHEME	... ...	292

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